11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

393 Dr. Elmes testified that although the technology of measuring the quantities of asbestos in the air was not then available, and one can therefore only estimate, it is safe to assume that before regulations were introduced in Great Britain in 1933, workers in asbestos textile factories experienced levels of exposure in the region of several hundreds of fibres per cc or higher. After those regulations were introduced, he said, exposure levels dropped to about 20 or slightly more fibres per cc. For a time, he said, it was thought that the sharp reduction had brought an end to the asbestos-related disease problem.

394 But, by the early 1960s, that optimistic outlook had been shattered by what he referred to as the "devastating" new findings about mesotheliomas. Dr. Elmes said that it was a paper written in 1960 by Dr. Chris Wagner (another pre-eminent researcher in the field of asbestos-related diseases) that first demonstrated a definite correlation between asbestos fibres and mesotheliomas. The paper, Dr. Elmes said, was at first greeted with some scepticism. However, by the time of the 1964 New York conference, it was acknowledged in the medical community that there was some sort of causal connection between the two.

395 Dr. Elmes also noted that, while their frequency had dropped "tremendously", there were still cases of asbestosis and lung cancer appearing in the post-1933 echelon of workers. Thus, by the early 1960s, it was apparent that the 1933 regulations had not been entirely effective in preventing asbestosis and lung cancer. More stringent regulations were required and, as previously noted, in 1969 a standard of two fibres per cc was adopted in the United Kingdom.

396 By 1964, Dr. Selikoff was reporting a high proportion of asbestos-related disease in the cohort of insulation workers that he was studying. One of the great concerns at the time was to establish safe levels of exposure and, in order to do so, it was important to determine what the dose-response relationship was. Dr. Elmes testified that there was then no generally accepted method for measuring the quantities of asbestos fibres in the surrounding air. It was not until 1969 that an air sampling technique was developed in the United Kingdom that was considered satisfactory for the purpose of monitoring occupational exposure to asbestos. Even that technique had two recognized limitations: it could not distinguish between the different types of fibres that were present, and it was accurate only down to about one fibre per cc.

397 The first "major" conference on the subject of asbestos-related diseases attended by Dr. Elmes was that assembled by the New York Academy of Sciences in 1964. He attended in order to report on what he and his associates had learned from their study of a cohort of insulation workers about the risks of contracting lung cancer and mesothelioma, and to find out what others had discovered.

398 Dr. Elmes said that one of the "puzzles" apparent by 1964 was that there were marked differences in the incidence of mesotheliomas, depending upon the type of asbestos fibre to which the individuals concerned had been exposed. Those exposed to crocidolite fibres showed a much higher incidence of mesothelioma than those who had been ex posed to chrysotile. He said that one of the things that he and the others who were on the epidemiology panel wanted to do was to "sharpen up the evidence" by conducting more careful studies of the risks associated with the milling and mining of the different types of fibres.

399 Dr. Elmes was a member of the epidemiology panel at the 1972 IARC Conference, where he presented papers on the clinical course of mesothelioma and the management and treatment of that disease. He was a member of the committee that prepared the 1972 IARC Report ("The Report of the Advisory Committee on Asbestos Cancers to the Director of the International Agency for Research on Cancer"), which, as I noted earlier, he described as a fair reflection of the state of knowledge at that time. The findings of that committee, of which Dr. J.C. McDonald, Dr. Irving Selikoff, Dr. J.C. (Chris) Wagner, and several other distinguished scientists were also members, are as follows:

> (1) There are clear differences in risk depending on the type of fibre and nature of exposure.
>
> (2) The risk of lung cancer is not detectable when the occupational exposure has been low. (Low being still much greater than that received by the public from general air pollution.)
>
> (3) There is no evidence of a risk of lung fibrosis from low levels of exposure to asbestos, such as have been encountered by the general population in urban areas.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

(4) There is evidence that the risk of contracting mesothelioma varies with different occupations and different types of asbestos. The risk is greatest with crocidolite, less with amosite and less still with chrysotile. There is also evidence from population studies that a proportion of cases of mesothelioma have no known association with asbestos.

(5) There is no evidence of a risk to the general public of contracting mesothelioma from low levels of exposure to asbestos.

400 Dr. Elmes testified that the differences in the way in which the three main types of asbestos fibres behave in the lung over the long term was not appreciated until the mid-1970s. By then, he said, it was realized that within a few weeks following exposure to asbestos, some 15 to 20 percent of the inhaled fibres are expelled from the lungs. After that time, the amphiboles stay in the lung and, after a year passes, roughly the same numbers of those fibres are present, and they retain their size and shape. Chrysotile fibres, on the other hand, split up into individual fibrils, so that one will find more individual fibres, but they will be thinner and shorter. Because of this, Dr. Elmes testified, the smaller chrysotile fragments are cleared from the lung by what are called "phagocytes", the lung macrophages. He described the macrophage clearance process as follows:

Q. And you used the expression macrophage clearance cells, could you explain to his lordship what you were referring to there?

A. In the breathing part of the lung the little sacs called alveoli are lined with three kinds of cells, there are the flat cells, which allows the gas transfers, there are little brown cells called type 2 cells which produce a sort of film also a factant which protects the surface of the alveoli and stops the alveoli from collapsing when you breath out. And the third cell is the macrophage, which is a cell which picks up foreign bodies, matter, scavengers, and they may be specialized in the lung, but they are just the same in their function as the macrophages in other tissues of the body and also monocytes in the blood that circulate in the blood. They are a general class of do-gooders in the body.

Q. So there is a clearance mechanism that the body has built into itself to protect itself from dusts including asbestos fibres?

A. Yes. The ones that get down below the ciliated mucous covered airways which work like an escalator any dust that lands on them gets taken back up to the larynx and swallowed. These are secondary defences, the macrophages.

401 Dr. Elmes testified that animal experiments have shown that within six to nine months after exposure, one-half of the chrysotile fibres initially taken into the lung will be cleared in this way.

402 Dr. Elmes also testified that in recent years comparisons have been made between the lungs of people who had once worked in an asbestos industry but had ceased to be exposed to chrysotile some five to ten years before they died and those of persons who were still employed in the industry at the time of their death. It was found that the fibre content of the lungs of the first group was indistinguishable from that of the general population, whereas those still engaged in the industry had lung burdens well above those of the general population.

403 With regard to the significance of fibre size, Dr. Elmes testified that:

The airways going down into the lung tubes ... get progressively narrower as they divide and become more and more frequent out into the lungs ... [T]hey divide ... into two equally sized tubes but smaller than the original tube so they get narrower and narrower as you go down, and, obviously if you inhale in the air a large particle of dust, it will get down the -- clear the main area and one of the main branches, but it will get stuck at some stage or other because it's too big. But usually before that, especially at the bifurcation, the air coming down, it will get thrown against the side and then stuck, so that this is a filter mechanism protecting the lung and it means that particles of dust larger than five microns in diameter, rounded particles of dust, I don't mean perfectly round, they can be, you know, roughly

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> round, don't get down and damage the lung be cause they get filtered out by this mechanism and cleared by the escalator. And once you get down below that, then some of the dust particles can get down beyond this level, which is right out near the air exchange part of the lung and they can get stuck there. Now -- so that you got a fairly rigid demarcation between the dust which is too big to do any harm and dusts which are harmful, if they are rounded. Now, it's not so easy with long particles. It is in the nature of things that if you got a lot of air down a tube it goes fastest down the middle and more slowly at the sides. And if you have in that air elongated particles, this means that they line up parallel to their direction of flow, so that they get down the tubes in relation to their diameter and not their length. The length, you can get a particle that is quite long, a hundred microns, say, long, it can get down into the lung as long as it stays straight, but when it gets down as far as it's going to go in that breath, there is a period when the thing stands still and then you start to breathe out and during that period it may have twisted one way or the other and get caught on the side and the effort of breathing out then will then drive it into the wall. So that as long as the particles are narrower and they have to be below three microns in diameter, quite big particles will get stuck well down in the lung and get into the lung tissue by that mechanism. So that this is another reason why fibres are potentially more dangerous than rounded particles.

404 Concerning mesotheliomas, Dr. Elmes stated that there is clearly a difference between the different types of asbestos fibres as to the degree of risk involved. He stated that there must be a long period of interaction between fibres and tissue before a mesothelioma is produced, and he noted that, while chrysotile fibres disappear from the lungs within a short period of time, crocidolite fibres can stay in the lung for 30 to 40 years.

405 Dr. Elmes was asked for his opinion as to whether chrysotile asbestos can cause mesothelioma. He stated that while the evidence is that it can do so if injected straight into the pleura of animals, the evidence so far as humans are concerned is getting "more and more doubtful".

406 Dr. Elmes discussed the state of medical knowledge, as at 1990, concerning the asbestos-related diseases. He said that based upon what was known then (and today), he does not believe that one has to have asbestosis before one can contract lung cancer. He also said that he would not expect to see cases of asbestosis occur as a result of exposure to the levels of chrysotile asbestos typically found in buildings, nor would he expect to see cases of lung cancer.

407 He said that what is still not known is whether chrysotile asbestos, by itself, at high doses can cause cancer in non-smokers. When asked whether it is possible, he stated:

> I mean I couldn't cross my heart and say never could cause it, but in the absence of cigarette smoking you have to be exposed continuously to a very high level of asbestos to produce it; I'd put it that way ...
>
> ... I am talking of levels of a thousand fibres per cc or higher everyday your working day for a working lifetime.

408 Dr. Elmes was asked about a paper written by Dr. Wagner and published in the *British Journal of Industrial Medicine* in 1991. He indicated that he was familiar with the paper and in fact had discussed it with Dr. Wagner before it was sent in for publication. In that paper, Dr. Wagner states that there is no evidence of increased risk of mesothelial cancers at low levels of exposure to asbestos. He states that there is definitely no risk to the general public, except when buildings containing crocidolite are being demolished. Dr. Wagner further noted that the wholesale removal of chrysotile from buildings is absurd. Dr. Elmes indicated that this was one of the specific points that he discussed with Dr. Wagner, and that he agrees with those conclusions.

409 According to Dr. Elmes, chrysotile fibres, at the levels found in buildings today, do not cause mesothelioma. He stated that this conclusion applies to all building occupants, including maintenance and custodial workers, who might be exposed to cementitiously applied fireproofing containing chrysotile asbestos.

410 Dr. Elmes was asked to comment on Dr. Frank's suggestion that mesothelioma appears to be related mostly to short chrysotile fibres, and that fibres less than 5 microns in length can cause mesothelioma. Dr. Elmes disagreed. He said that, in his opinion, the bulk of the evidence suggests that there is no risk of disease from fibres below 5 microns in length.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

411 In Dr. Elmes' opinion, there is a level of exposure to asbestos below which one will not contract any of the asbestos-related diseases. That level, in his view, is at, or above, the two fibre per cc limit set some time ago.

412 Dr. Elmes also gave evidence about the risk associated with the presence of asbestos in buildings. As in the case of Dr. Frank's testimony on this matter, I will discuss Dr. Elmes' views later, under the heading, "Asbestos in Buildings".

Dr. Churg

413 One of the areas of research that is of particular interest to Dr. Churg is the analysis of asbestos lung burden. Simply put, that is the study of how much asbestos there is in a lung. It requires the determination of the type, size, number and distribution of fibres in the lung. Once that data has been obtained, Dr. Churg tries to correlate it with the presence or absence of disease.

414 Much of Dr. Churg's work is based on epidemiological studies. Such studies, he stated:

> ... are population studies looking at disease in populations. Epidemiologic studies in many senses regard the person as a black box, by which I mean, you really don't know anything about what's going on inside, you may know a patient has a disease or doesn't have a disease. I think as a pathologist interested in asbestos-related disease, the only way I can understand where to look is to know what the epidemiology says. And I use epidemiology to guide me as to what are current issues. So that will determine what I am looking at and we will hear more about that later. What I am looking at, what sorts of tissues I am analysing, what sorts of correlations I am looking for in terms of disease.

415 While Dr. Churg readily acknowledged that he is not an expert in epidemiology, he maintains that he is capable of reading the relevant studies and applying their findings and conclusions to his own work. It is his belief that the most reliable conclusions are those drawn from epidemiological data and fibre burden studies.

416 He is reluctant to accept animal or in vitro studies on asbestos as a substitute for epidemiological studies. This became apparent during cross-examination when, in response to a question about an in vitro study where elevated levels of DNA were found after asbestos was added, Dr. Churg replied:

> I won't argue you that in a test tube asbestos does things to the DNA, but what I would argue with you, I don't know how to take that data and translate it to the human condition ... It's a basic problem of trying to take this data and I have this data and therefore something happened in man.

417 Dr. Churg testified at considerable length about the effects of chrysotile asbestos. He, too, said that it was not until relatively recent times that it was understood that chrysotile behaves quite differently in lung tissue from amphibole asbestos. He testified that the behaviour of chrysotile, once inhaled, is distinctive in that it is very rapidly removed from lung tissue.

418 Dr. Churg discussed this finding in the context of his study of 94 chrysotile miners and millers from the Thetford Mines region in Quebec, and stated that:

> ... chrysotile, as I am sure has come out in this case, has in it as mined both chrysotile and the amphibole tremolite. Now, if you look at the concentration from our data of tremolite as a function of exposure time in these 94 miners ... the more exposure you have in terms of years of exposure the more you have in your lung makes sense. But that's not true for chrysotile. If you look at chrysotile, you get a line that is statistically dead flat. *In other words, despite the fact that these are chrysotile miners, they are exposed and these miners are exposed historically to high levels of chrysotile despite the fact that these miners are exposed to an ore which is on the order of analysis of 99 percent percent [sic] chrysotile, chrysotile does not accumulate in their lungs.* (emphasis added)

419 Dr. Churg made several significant points about asbestos and its apparent health risks. First, he stressed that asbestos cannot produce disease until it is inhaled. In that regard, he said:

> ... I think the popular press has been influenced by too much noise about asbestos in such a way that people regard asbestos with an unholy fear. And there is no basis for doing so. Asbestos produces disease if you inhale it in sufficient quantity. If you inhale it in low quantities, then in general it doesn't produce disease. And if you don't inhale it, then it doesn't do anything. Although it sounds self-obvious there is a tremendous panic that the press I think keeps pushing that the mere presence of asbestos in a certain location equates to disease. And that's not true at all.

420 Dr. Churg also stated that, in his opinion, there is a clear dose-response relationship with respect to asbestos. In other words, the more you inhale, the greater the risk of getting the disease.

421 Another point he made related to what he termed a "surprising" finding from his study of the lung burdens carried by the general population of Vancouver. Dr. Churg's studies have revealed that practically everyone is carrying a "very substantial" burden of asbestos, what he calls a "background lung burden". He stated that if he were to examine the lungs of 20 people, he might find asbestos in the lungs of as many as 19 of them despite the fact that they had never worked occupationally with asbestos. The significance of this finding was stated by Dr. Churg to be as follows:

> The point here is ... that we all have a lot of asbestos in our lungs ... Therefore, the notion that any kind of exposure to asbestos is going to produce disease, and I say any kind, any time you are exposed to any amount, to me becomes ipso facto ridiculous because we are all [walking] around with this burden of asbestos, [and] none of us are dying of asbestos-related diseases ...

422 Moreover, Dr. Churg noted that even those people who carry a higher lung burden than the general population do not necessarily become sick. For example, he noted that studies have shown that the lungs of lifetime residents of mining towns who have never worked in the industry, nor had any relatives in the industry, carry 5 to 10 times the lung burden of chrysotile and tremolite that would be found in lungs of most people. He stated the significance of this fact to be as follows:

> These observations provide clear evidence that exposure to chrysotile asbestos at several hundred times urban background, (a level much greater than a typical building exposure), for a whole lifetime produces no deleterious effects on health.

423 Dr. Churg also discussed the three asbestos-related diseases -- asbestosis, lung cancer, and mesothelioma. Dealing first with asbestosis, he noted that it is a very serious, disabling disease in terms of one's ability to work. But he stressed (as did the other expert witnesses, including Dr. Frank) that asbestosis is only encountered where there has been very high exposure to asbestos and where the person's lungs contain a very large number of fibres. As an example, he noted that a study of shipyard workers revealed that their lungs contained about 26 million fibres of amosite, whereas the average number that a person will carry is about 1,000. He referred also to a study of chrysotile miners in whose lungs were found slightly over one hundred million fibres, compared with an average in Vancouver of 3 to 4 hundred thousand.

424 The "bottom line", according to Dr. Churg, is that it takes an "awful lot" of asbestos to produce asbestosis. He stated that assuming building exposures are in the range of .0002 fibres per cc -- a figure taken from the Health Effects Institute of Asbestos report as being typical -- there is simply no risk at all of building occupants contracting asbestosis.

425 Dr. Churg also discussed the relationship between asbestosis and lung cancer. In his opinion, asbestosis is "strongly associated" with the development of lung cancer, to the point that the "threshold" for lung cancer is the presence of asbestosis. In Dr. Churg's opinion, if you don't have asbestosis, then mere exposure to asbestos does not create any additional risk of contracting lung cancer.

426 Dr. Churg pointed out the distinction between lung cancer (a malignant tumour developing in the substance of the lung) and mesothelioma (a malignant tumour developing on the covering of the lung). He stated that, in his opinion, asbestos, and specifically chrysotile-based asbestos, does cause mesothelioma. But, he said, as with asbestosis, it takes an "enormous burden" to produce a mesothelioma in man, and, as is the case with asbestosis, a mesothelioma cannot be caused by building

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

level exposures to chrysotile fibres.

427 In cross-examination, Mr. Roberts put to Dr. Churg a report which discusses four cases of mesothelioma found in school teachers who had no other apparent exposure to asbestos than in their schools. When asked whether there could be any reason other than their exposure to asbestos that could account for the mesothelioma, Dr. Churg responded:

> Sure. A very good reason. The basic reason is we have four case reports and the question is how many school teachers are there in the United States? 100,000, half a million? A very high number, clearly. I don't know. There's incidence of spontaneous mesothelioma in the general population. One has to start examining a large population of whichever profession you might pick. We can pick lawyers, but we have schoolteachers. You will background spontaneous mesotheliomas simply because you are examining a large population.
>
> You then run into exactly this problem. Lilienfeld has accumulated these four cases. There is no evidence that these fours cases are really actually any increased incidence over background for the population as a whole. Simply is a large population to draw from. They may well have been referred to him because of his interest. This sort of study is simply anecdotal. Until you have proper epidemiology to say these school teachers in asbestos buildings are at risk, you don't know if this is really what you expect from background.

428 I think it significant that a similar response was given by Dr. McDonald, referred to later, to a question concerning mesotheliomas found in a small number of German mechanics.

Dr. Crystal

429 In the first part of his testimony, Dr. Crystal provided a general overview of the workings of the lung. He explained that the lung, which transfers gases from the air to the blood, has many defence mechanisms to protect the functioning of its tissues and allow it to perform its tasks. He noted that, to be inhaled, a fibre of asbestos would first have to be of "respirable" size, that is, sufficiently small to enter the respiratory tract. Assuming that the fibre passed this hurdle, a multitude of defence mechanisms would, more often than not, prevent it from entering the lung.

430 Dr. Crystal stated that:

> The vast amount of -- "vast" meaning 99.99 -- I mean the vast amount of asbestos fibres never get to the lung. They will be removed in the upper part of the airways, and if they do get down to the lung passages, the air passages, they will be removed by the cleaning mechanism along the -- the walls of the airways, that the -- bronchi, and if they do get down, a very small percentage, they get past all those defence mechanisms and get down to the alveoli, they most likely will be removed or just sit there. And we know that all of us have asbestos fibres in our lung that are absolutely innocuous and don't cause disease.

431 In Dr. Crystal's opinion, there is a level of inhalation of asbestos fibres below which there is simply no risk at all of contracting any of the asbestos-related diseases. He prefers not to describe this as a "threshold" because that word, in his view, erroneously connotes some sort of "on-off switch", whereas, in reality, there is a range, rather than one particular point, where disease begins to be found. According to Dr. Crystal, this range is between 10 and 100 fibre years per cc. Below 10, he said, there is no evidence of there being any risk of disease.

432 Speaking about asbestosis, he stated that it is associated with the inhalation of any of the three major types of asbestos fibres -- chrysotile, crocidolite and amosite. But he emphasized that they must be inhaled in large quantities over a long period of time before there is a risk of asbestosis. He further noted that the majority of people who inhale even large quantities of fibres over a long period will not get the disease.

433 With respect to lung cancer, Dr. Crystal stated that the literature shows clearly that a person who has had high and long exposure to asbestos, and who is or has been a smoker, has an increased risk of developing lung cancer. However, he noted that there is no clear evidence of there being an increased risk in the case of a person who does not smoke cigarettes.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

According to Dr. Crystal, very few individuals who are life-long non-smokers develop lung cancer.

434 Dr. Crystal stated that, in his opinion, the third category of disease, mesothelioma, is "quite different" from the other two, in that it has no connection with cigarette smoking, and is only associated with two of the fibre types -- crocidolite and amosite. He said that, like the others, mesothelioma requires the inhalation of large amounts of asbestos fibres for long periods of time, and the ambient air in buildings is far below what is required to cause the disease.

435 Dr. Crystal discussed the concept of "spontaneous mesothelioma", cases in which there is no known etiology. In his opinion, only 60 to 70 per cent of cases of mesothelioma are associated with asbestos exposure.

436 When asked what the effect would be upon the physiology of the lung of a person who was inadvertently subjected to a high level of asbestos exposure for a short period of time, Dr. Crystal replied:

> Well, the defence mechanisms are very redundant, and although they may be overwhelmed occasionally for the short term, that does not lead to disease. You have to -- *the defence mechanisms have to be overwhelmed chronically for long periods of time, and there is no evidence that one time or even a few times high intensity, short exposures are associated with disease.* (emphasis added)

437 Dr. Crystal was asked for his opinion of the studies by regulatory agencies that suggest, contrary to his conclusions, that there may be some risk of disease at low levels. He responded:

> ... what the regulatory agencies ... have done, and justifiably so for their -- their mandate, is they've said, "We have to come up with some theory. We have to come up with some risk assessment in terms of what levels we will allow workers to be exposed to". And so what the regulatory agencies have done ... is to say, "Let's take the data that exists and theorize what the risk would be at the low levels". The simplest model to use is a linear model.

438 Under a linear model, Dr. Crystal explained, a straight line is drawn, corresponding to increasing levels of exposure. However, he noted that below 100 fibre years per cc the line is completely theoretical, without any data to support it. Taken to the extreme, he said, such a line would suggest that one single asbestos fibre must create a risk -- Dr. Frank's position -- a proposition he described as "absurd" given the number of fibres we carry within our lungs. In fact, Dr. Crystal's studies, like those of Dr. Churg, have revealed the presence of significant quantities of asbestos in the lungs of the general population.

439 Dr. Crystal made some general observations about the utility of various types of studies. He noted that what gave an epidemiologic study its value was its use of a control group. Thus, for example, a group of workers exposed to asbestos in a building might be compared to another group of workers in a similar building not containing asbestos; the effect is to reduce solely to asbestos the variable between the groups. This, according to Dr. Crystal, is very different from an anecdotal study where an individual who worked in a building containing ACM develops one of the three diseases and a conclusion is drawn that the disease has something to do with the presence of asbestos. This latter approach, which was followed in several studies which suggest that the presence of an ACM in a building creates an increased risk of contracting an asbestos-related disease, is not, in Dr. Crystal's opinion, scientifically sound.

440 Dr. Crystal was asked to comment on two other types of study: in vitro and animal. He said that he had often used in vitro studies, but, like Dr. Churg, he suggested caution in their application. He stated:

> There are many limitations to in-vitro [sic] studies. What in-vitro [sic] studies are, for example, taking cells and studying them with a test tube, for example, adding asbestos, adding a cell to them or adding a chemical. I could think of many different variations. But cells outside the body may or may not behave the way they do inside the body, and the techniques are not available to have cells, for example, the lining cells of the lung in humans to behave the same way they do inside of the human. And so the studies, the in-vitro [sic] studies that are published a lot are all using various kinds of cells that bear no relevance ... necessarily to the cells in the body in the lung. That doesn't mean that in-vitro [sic] studies are not useful, and I carry them out as well, but you have to interpret them with caution, and the important thing is the human experience, what actually has been observed in humans, not what goes on in the test tube.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

441 Dr. Crystal expressed similar caution with experimental studies in animals.

Dr. McDonald

442 While he was at McGill University, Dr. McDonald studied all of the diseases that are attributed to asbestos exposure. He indicated that he was not aware of any group that has been as continuously and widely active in this area or research as his team at McGill.

443 Asked what factors are relevant to the risk of contracting asbestos-related diseases, Dr. McDonald replied:

> There are several but I must give priority to the intensity and duration of exposure. All asbestos diseases that I know have either been demonstratedly [sic] related to exposure, variously measured, or whether the evidence strongly suggests it ...
>
> Oh, and I missed, of course, a very major point, and that is the type of asbestos. I have indicated already there are several types of asbestos. The word "asbestos" merely means a fibrous mineral silicate which is of commercial use. That's all the word means. There are then, if you like, geologically, mineralogically, the various types of asbestos which are chemically, physically quite different from one another but they are all mineral fibre silicates which industry from time to time has used, and fibre type is an important variable.
>
> There are other variables such as the size of the fibre, in particular length and diameter, where I think there's general agreement that for practical purposes it's only really the long fibres that are of any importance, long, thin fibres.

444 Dr. McDonald stated that it is his opinion that there is a systematic relationship between concentration and risk, meaning that increased exposure increases the risk of mesothelioma. He stated:

> ... it is now, I think, reasonably clear, though on much less evidence than exists for lung cancer, for example, but reasonably clear that the probability of getting the disease [mesothelioma] is related to the main characteristics of exposure, that is, duration and intensity. And that applies whether it is to commercial chrysotile or to commercial amphiboles, but, of course, at different levels of risk.

445 Dr. McDonald testified, however, that this systematic relationship is not applicable in low levels of exposure, such as those encountered in buildings. He stated:

> ... I think this is where we have to start defining terms, what are we thinking about when we say "low". In general, until very recently, the only concern among those who have been studying the health effects of asbestos has been basically to determine the risks for -- occupational risks for people working with asbestos in order to identify the control levels which will make an acceptable working environment. And when we are talking about that, low means, let us say, under five fibres per cc. That means low in occupational terms and, indeed, most -- in most countries where asbestos is controlled now, which is controlled fairly strictly, in many countries, of course, the -- most countries have very strict controls for the crocidolite and amosite, particularly crocidolite and when we talk about controls we are really talking more about chrysotile. And for many countries, the countries are now working at perhaps two fibres per cc, one fibre per cc, half a fibre per cc. So you see we are then working at -- that is low occupational levels. And indeed, when we have those levels, that implies that these are the levels which the national bodies think are sufficient to prevent disease but, of course, the concept of low has a different meaning which has come up in relation to the general environment and in relation to buildings, which has been a concern, and now we are talking about levels which are maybe several orders of magnitude below that.
>
> Q. Yes?
>
> A. Buildings have variously observed rates which might -- I mean concentrations of fibres, not necessarily asbestos

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> but fibres, perhaps 1/10,000 of the lowest occupational control limit and so there is now concern expressed in various places about that kind of level. Is that a thing -- can we dismiss that or do we have to take that seriously? And that is where we have to look at exposure response information to see if we can -- for light on whether or not there's any reason to be concerned about that type of level.
>
> Q. And based on your experience and training, do you feel that at exposures 1/10,000 of the occupational levels, that there is a concern with regard to mesothelioma and lung cancer?
>
> A. *No. To me, in light of my experience, it is inconceivable that there could be a risk. Any suggestion that there is one is done by extrapolation. It's not by observation. There is no way in which you could observe even the risks which probably are related to even the lowest level of occupational exposure. There's no way we could mount a study now in Quebec which could demonstrate any risk of an industry working at say, half a fibre per cc. We couldn't find that. We know that the lowest level we've ever able to find any evidence of a risk is around 20 fibres per cc for a lifetime. We have to put it in context. So epidemiologically nobody could detect that kind of risk, so if we say there is one, that is speculation. Now, you could examine the speculation, what is that speculation based on, but it becomes entirely speculative.* (emphasis added)

446 Dr. McDonald's research group conducted an epidemiologic study of the effect of various fibre sizes. It was based on cases of mesothelioma from right across Canada. He said that the results of the study show that only fibres above a certain length contribute to mesothelioma. Moreover, the study showed that mesothelioma was common with exposure to amphibole, but rare with exposure to chrysotile, the former creating a risk approximately twenty times higher than the latter.

447 Dr. McDonald was asked to quantify the risk of contracting mesothelioma as a result of exposure to chrysotile asbestos fibres. He said that the best data came from his study of 12,000 Quebec miners, where five cases per one thousand people were discovered. But, he added, that figure was based on exposure levels during the 1930s-1950s, which were "astronomic" compared to today's. He stated that the miners were then exposed to an average of 150 fibres per cc, compared to 1/2 fibre per cc in Quebec mines today.

448 During cross-examination, Dr. McDonald was asked about ten cases of mesothelioma, identified by a Dr. Woitowitz, in mechanics who serviced brakes on motor vehicles in Germany, between the period 1980-1985. According to Dr. Woitowitz, these workers were only exposed to chrysotile. Dr. McDonald was asked why this study was not useful for persons concerned about the public's health in relation to asbestos exposure, and he responded:

> Well, I think mainly because it is not an epidemiological study and, therefore, I think the writer does not appreciate quite what he is saying.
>
> Let me explain. He says, for example, that we have found 10 cases ... in mechanics. There are now a quarter of a million employees in this work. If you like to do a proportional sum on that, you'll find that that is approximately the number of mechanic -- cases in mechanics you would expect by chance. You have to understand that. ... It's almost dead on what you'd expect by chance.

449 According to Dr. McDonald, the latency period (i.e., the time from first exposure to manifestation of disease) varies with each of the three diseases, and for asbestosis, it varies with the amount of exposure. He stated that in the early days, when there was little regulatory control over asbestos exposure, asbestosis could manifest itself in five to ten years. He suggested that even with slightly lower levels, you seldom get evidence under twenty years. For lung cancer and mesothelioma, the latency period varies between thirty to forty years. He noted that with high exposure, mesothelioma may be discovered after 20 years.

450 Dr. McDonald has charted the incidence of mesothelioma since 1970, and has found that the number of cases involving males has risen at a rate of 10 per cent per annum. He suggested this rate of increase will continue for the next 20 years. In his opinion, the increase reflects the use of asbestos some 40 years earlier in four main types of work: insulation (which accounts for the highest incidence); shipyard; construction; and asbestos factory work. He stated that his findings are

11 B.C.L.R. (3d) 1, [1995] 10 W.W.R. 385, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

comparable to those in other studies from the U.S., the U.K. and the Scandinavian countries.

451 The increasing rate in males stands in sharp contrast to females, which remains constant. The significance of this fact is stated by Dr. McDonald as follows:

> To me it implies that exposures to asbestos at that time were -- short of occupational exposures -- [were] not sufficient to affect the detectable level of mesothelioma in this very large population.

452 Hence, the indirect exposure they received from their husbands (i.e., washing clothes, etc.) was insufficient to increase the frequency.

453 Dr. McDonald noted that once you take out the occupational mesotheliomas, you have the same frequency in both men and women, which is approximately one to two cases per million population.

454 Turning to asbestosis and lung cancer, Dr. McDonald was asked where the former is a prerequisite to the latter. He indicated that he kept an "open mind" on this question, but that:

> ... the three go together so closely that in practice it must be very rare that you get a lung cancer that is not -- in which the worker does not also have some sign of asbestosis. It's very rare.
>
> On the other hand, we can't assume that that applies to lung cancer in the general population.

455 He said that he is presently studying this question, and that it is a very important question. He noted two primary groups who are interested in learning the answer. The first are researchers interested in understanding why we get cancer. It is important to them, he said, to know whether the same mechanism is involved in both diseases, i.e., whether fibrosis is a prerequisite for cancer production. The second group interested in this question are Compensation Boards. Dr. McDonald stated that since approximately twelve per cent of all males die of lung cancer, it would be helpful for the Boards to know if these people have a valid claim, in the sense of having had sufficient exposure to asbestos.

456 In cross-examination, Mr. Roberts put to Dr. McDonald a paper he had written in 1980, in which he suggested that asbestos was a cause of lung cancer, and that the carcinogenity of asbestos was independent of, although enhanced by, tobacco use. Dr. McDonald's response was immediate and forthright. He said that over the years he has become less dogmatic on this point and more "dubious about the ability of asbestos without any carcinogenic to produce lung cancer ..."

457 I accept Dr. McDonald's explanation and his current opinion on this point. The fact that he has changed his opinion does not suggest, as argued by the plaintiffs, that he is an unreliable witness. Rather, it is indicative of a reasonable evolution of medical opinion following further years of study.

458 Dr. McDonald indicated that the link between mesothelioma and asbestos is much more distant and uncertain. He indicated that cases of mesothelioma have been discovered outside of North America that were unrelated to exposure to asbestos. When asked whether it was reasonable to suggest that when one encounters a case of mesothelioma, one should immediately assume asbestos exposure unless otherwise proven (Dr. Frank's view), he replied:

> Absolutely not. For example, in women, it's relatively seldom that asbestos is the cause of mesothelioma, probably not more than ten percent of [the] mesotheliomas in women are attributable to asbestos exposure. In men, as I pointed out yesterday, the frequency of mesotheliomas is going up, steadily, and, therefore, as time passes the proportion of mesotheliomas in men, in males, that are associated with asbestos is increasing. So today in men probably asbestos exposure can explain in the order of 85 percent of them. But when we started work on mesothelioma in 1969, probably asbestos exposure only explained about 20 percent of the males cases. So there is no absolute figure, it's a figure that changes in time and place.

459 Dr. McDonald testified that his study of textile plants revealed two main findings concerning mesothelioma. First, there was something about the textile industry that increases the lung cancer risk, but not the probability of mesothelioma,

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

and second, the risk of mesothelioma was not high in chrysotile plants.

460 Finally, Dr. McDonald was asked about the risk of contracting mesothelioma at various fibre concentrations. He suggested that the risk at one fibre year of exposure was approximately one in ten million. He stated that it was not his role as an epidemiologist to decide whether the community should "worry" about that type of risk, but suggested that it is a risk that "has to be put in context of the other risks of life".

461 The plaintiffs led a great deal of evidence as to the extent of the Grace defendants' knowledge about the health hazards associated with asbestos. It is not necessary for me to closely review that evidence for there is no dispute on this point. During the relevant time period, leading up to and including the installation of the product in the Building, the principal officers of both Grace defendants were very familiar with the subject.

462 However, in my view, the fact that the Grace defendants were fully aware of the dangers associated with the use of asbestos has little legal significance in this case. They do not say that asbestos itself is *never* a health hazard, or that they did not know that it was a hazard in *certain circumstances*. Rather, they maintain that the asbestos fibres *in Monokote MK-3* did not contaminate the Building and do not constitute a health hazard.

XII. Regulatory Action

Introduction

463 In this section I will discuss the actions taken with respect to asbestos-containing spray materials by regulatory authorities in the United Kingdom, the United States and British Columbia.

464 The plaintiffs argue that the WCB regulations are not designed to deal with the safety of asbestos in buildings and, accordingly, are of no assistance in determining the safety of MK-3. I disagree. In my view, the regulations set by both of those bodies are relevant to the question of the safety of the product MK-3.

465 No doubt these regulations, in and of themselves, cannot answer the question as to whether or not MK-3 was, as the plaintiffs allege, an inherently dangerous product. But, in my opinion, the history of regulatory action taken by the WCB provides a valuable, historical glimpse into the important -- and for the purposes of this action, the most important -- Canadian regulatory body's perception of the potential dangers of exposure to asbestos-containing building materials.

The United Kingdom

466 Dr. Elmes provided a considerable amount of information about the activities of the regulatory authorities in the United Kingdom with respect to the use of asbestos-containing materials. While not directly relevant to the issues in this case, his testimony furnished an interesting and useful look at the steps that have been taken in that jurisdiction to reduce the risk to workers of contracting an asbestos-related disease.

467 In the early 1930s, Dr. Merriweather, then the Chief Medical Examiner of Factories, reported on the serious dust conditions in the asbestos textile factories in Britain. Dr. Merriweather found that workers engaged in the textile spinning and weaving processes, as well as those whose work it was to open and blend the bags of material, were getting asbestos-related diseases within five to ten years of starting work. As a consequence of his studies, regulations were introduced in the United Kingdom in 1933 which applied, not only to the asbestos textile industry, but also to other factories where workers dealt with raw asbestos and incorporated it into other forms of manufactured goods.

468 Prior to 1933, Dr. Elmes testified, the technology of measuring asbestos in the air was not available, and it is only possible to estimate that, in those factories that Dr. Merriweather examined, the exposures were several hundred fibres per cc of air, "and maybe more". Because the means of measurement were not available, the 1933 regulations, according to Dr. Elmes:

> ... simply said people doing this work must wear protective clothing, they must wear a mask if -- unless you can

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> control the whole process in a box and control the dust by exhaust ventilation so that the air looks as clear as it does in the rest of the factory, we will say. And so that's how our regulations worked.

469 Dr. Elmes added that:

> ... we estimate that conditions in the late '30's after the 1933 regulation came in were exposing people to about 10, 20, perhaps a bit higher in some areas fibres per cc.

470 He said that one could estimate that the people working in those conditions were exposed:

> ... each day and throughout their working day to fibre concentrations of the order of 500 to a thousand or more fibres per cc, and in consequence they became ill within five to ten years and might die in under 20 years.

471 Dr. Elmes testified that, at the time, it was generally felt that:

> ... [the 1933] regulations were going to sort the whole thing out and that we weren't going to get any more problems with asbestos lung disease in industry. And, indeed, that's what I was taught when I was taught by Public Health Medicine in Cleveland in 1942.

472 And he said that:

> ... It looked as though everything was alright until Merriweather produced his next report in 1949 ... which indicated that there was another risk, not just asbestosis, but a risk of lung cancer ... He was the person who proved that there was a definite relationship, that the risk of lung cancer was increased by working with asbestos.

473 Dr. Elmes testified that in 1964, at the time of the New York Academy Conference, people in the field of occupational hygiene were still anxiously awaiting the development of air sampling techniques so that a dose-response relationship could be established and safe levels determined for the purpose of future legislation. He said that work in this area, which had been going on since the 1930s, was being done for the most part by the asbestos companies because, he said:

> ... it was in their interests to get a method of measuring it so that they could control the dust levels to certain standards and prevent the disease.

474 In 1969, after much discussion, a technique was adopted in Britain. It involved the use of a small pump and filter. Air was drawn through the filter, which was fine enough to collect the asbestos fibres in the air. After a measured quantity of air had been drawn in over a set period of time, the filter was removed from the pump, treated with a chemical substance to clarify it, and one could then, using the optical microscope, count the number of fibres that were of the size that could get into the lung and cause damage. Dr. Elmes described the process as "a very satisfactory technique for measuring and testing the situation in factories such as the ones who were covered by the '33 regulations". And, with minor modifications, it was adopted as the standard technique for monitoring occupational exposures to asbestos.

475 However, according to Dr. Elmes, it had two limitations. One was that it could not distinguish between the different types of asbestos. The other was that below .5 fibres per cc, it was unreliable. At that time, using the optical microscope, one could not see the finest of the fibres that could be retained in the lung and damage it. It was not until the late 1960s, he said, that "proper fibre counting techniques" became available.

476 According to Dr. Elmes, while one cannot know exactly how much of a reduction in exposure levels resulted from the adoption in the United Kingdom of the 1933 regulations:

> ... we've been able to recreate those conditions in some factories, and we know that they were exposed to 5 to, say, 30 fibres per cc in the thirties and forties gradually falling in the fifties, and so on, until the two-fibre limit was fairly easily achieved in industry by the end of the 1960's.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

477 The "two-fibre limit" mentioned by Dr. Elmes was the British Occupational Hygiene Standard of 2 fibres per millilitre (2 fibres/mL) established in Britain in 1969. This was stated to be "... a dose level designed to limit to 1% the risk of contracting the first signs of asbestosis".

The United States

478 A recurring theme in the plaintiffs' argument as to the allegedly hazardous nature of MK-3 is the action taken by the United States Environmental Protection Agency on April 6, 1973, when it enacted national Emissions Standards for three Hazardous Air Pollutants -- asbestos, beryllium and mercury.

479 Preliminary, as it were, to that action, several cities in the United States (notably, New York, Philadelphia and Chicago) had, in 1970 and 1971, taken steps to prevent the spraying of asbestos-containing fireproofing materials. In the fall of 1971, the EPA advanced proposals for a review of the practice, and in 1972, it began conducting hearings on the subject. That process culminated in the new standards promulgated on April 6, 1973, which banned all spraying in the United States of fireproofing materials containing more than 1% asbestos.

480 The bases for the Agency's decision are set out in a preamble to the regulations in the following words:

> Asbestos is a hazardous air pollutant ... Many people exposed to asbestos dust developed asbestosis when the dust concentration was high or the duration of exposure was long ... A large number of studies have shown that there is an association between occupational exposure to asbestos and higher-than-expected incidence of bronchial cancer ... Asbestos also has been identified as a causal factor in the development of mesotheliomas, cancers of the membranes lining the chest and abdomen ... There are reports of mesothelioma associated with nonoccupational exposures in the neighborhood of asbestos sources ... An outstanding feature has been the long period, commonly over 30 years, between the first exposure to asbestos and the appearance of a tumour ... There is evidence which indicates that mesotheliomas occur after much less exposure to asbestos dust than the exposure associated with asbestos ...
>
> It is not practicable, at this time, to establish allowable numerical concentrations or mass emission limits for asbestos. Satisfactory means of measuring ambient asbestos concentrations have only recently been developed, and satisfactory means of measuring asbestos emissions are still unavailable. Even if satisfactory means of measuring asbestos emissions did exist, the previous unavailability of satisfactory means of measuring ambient levels of asbestos makes it impossible to estimate even roughly the quantitative relationship between asbestos-caused illness and the doses which caused those illnesses. This is a major problem, since some asbestos-caused illnesses have a 30-year latency period.
>
> EPA considered the possibility of banning production, processing, and use of asbestos or banning all emissions of asbestos into the atmosphere, but rejected these approaches. The problem of measuring asbestos emissions would make the latter approach impossible to enforce. Either approach would result in the prohibition of many activities which are extremely important; moreover, the available evidence relating to the health hazards of asbestos does not suggest that such prohibition is necessary to protect public health. For example, demolition of any building containing asbestos fireproofing or insulating materials would have to be prohibited as would the use of materials containing even trace amounts of asbestos which would escape into the atmosphere.
>
> Finally, the available evidence suggests a gradient of effects from direct occupational, to indirect occupational exposure, to families of workers exposed to asbestos and persons in the neighborhood of asbestos sources -- in all of which situations asbestos concentrations are undoubtedly high by comparison with most community air. This suggests that there are levels of asbestos exposure that will not be associated with any detectable risk, although these levels are not known.
>
> It is probable that the effects of asbestos inhalation are cumulative; that is, low-level and/or intermittent exposure to asbestos over a long time may be equally as important in the etiology of asbestotic disease as high level and/or continuous exposure over a shorter period. On the other hand, the available evidence does not indicate that levels of asbestos in most community air cause asbestotic disease. Taking both of these considerations into account, the

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> Administrator has determined that, in order to provide an ample margin of safety to protect the public health from asbestos, it is necessary to control emissions from major man-made sources of asbestos emissions into the atmosphere, but that it is not necessary to prohibit all emissions ...
>
> ... the major sources of asbestos emissions were considered to fall into five categories: (1) mining and milling; (2) manufacturing; (3) fabrication; (4) demolition; and (5) spraying.

481 Referring to the earlier (December 1971) proposed standard, the preamble continues as follows:

> The proposed standard would have prohibited visible emissions of asbestos particulate material from the repair or demolition of any building or structure other than a single family dwelling. Comments indicated that the no visible emission requirement would prohibit repair or demolition in many situations, since it would be impracticable, if not impossible, to do such work without creating visible emissions. Accordingly, the promulgated standard specifies certain work practices which must be followed when demolishing certain buildings or structures. The standard covers institutional, industrial and commercial buildings or structures ... which contain friable asbestos material. This coverage is based on the National Academy of Sciences report [published in 1971] which states, "In general, single-family residential structures contain only small amounts of asbestos insulation. Demolition of industrial and commercial buildings that have been fireproofed with asbestos-containing materials will prove to be an emission source in the future, requiring control measures" ... The stan dard requires the Administrator to be notified at least 20 days prior to the commencement of demolition ...
>
> The proposed standard would have prohibited the spraying of any material containing asbestos on any portion of a building or structure, prohibited the spraying of any material containing asbestos in an area directly open to the atmosphere, and limited emissions from all other spraying of any material containing asbestos to the amount which would be emitted if specified air-cleaning equipment were used. Comments received pointed out that this would: (1) prohibit the use of materials containing only trace amounts of asbestos which occur in numerous natural substances; (2) prohibit the use of materials to which very small quantities of asbestos are added in order to enhance their effectiveness; and (3) prohibit the use of materials in which the asbestos strongly bound and which would not generate particulate asbestos emissions. The promulgated standard applies to those uses of spray-on asbestos materials which could generate major emissions of particulate asbestos material. For those spray-on materials used to insulate or fireproof buildings, structures, pipes and conduits, the standard limits the asbestos content to no more than 1 percent. Materials currently used contain from 10 to 80 percent asbestos ... Although a standardized reference method has not been developed to quantitatively determine the content of asbestos in a material, there are acceptable methods available, based on electron microscopy, which independent laboratories have developed ...

482 The EPA contacted Grace-Conn. directly regarding the impending ban and, in a letter dated July 31, 1972, advised them that:

> Asbestos emissions as a result of use of asbestos-containing fireproofing materials were extensively studied prior to our decision that banning spraying of asbestos-containing materials was necessary to protect the public health. Such emissions may occur during spraying, cleanup and disposal of overspray, and demolition of the building, and control in each of these operations is unsatisfactory. Thus, we feel the prohibition action is necessary. The building is a source when sprayed and when demolished, and one well recognized method of air pollution control is substitution of material that reduces potential emissions of the substance in question when such substitution is feasible.

483 Grace-Conn. continued the manufacture and sale of MK-3 in the United States until the April 1973 ban went into effect, and in this country, through its subsidiary, Grace Canada, until the late summer of 1975.

484 The plaintiffs make much of that decision, suggesting (as I have already noted) that it demonstrated:

> ... arrogant and reckless conduct by a multi-billion dollar corporation bent on wringing every last cent out of a product they knew was hazardous and which for that reason had been banned in the United States where this Defendant had its corporate headquarters.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

and that:

> After that ban [the Grace defendants] sought to extract that profit from sales in Canada by continuing their export of this environmental hazard to this country. Their attitude is no different from those who commit acts of environmental terrorism against third world countries we too frequently hear about. For this they should be made to pay and the amount of that payment should be large.

485 I will return later, in a more specific discussion of the product MK-3, to address the question of whether or not the Grace defendants considered, as the plaintiffs allege, that they were manufacturing and selling a dangerous product.

486 However, I think one final point regarding the action taken by the EPA must be emphasized. The EPA did not ban -- as is suggested in the first quote from the plaintiffs' opening statement -- either the production or sale of the product MK-3. What was banned was its *application by spraying*. Thus, MK-3 could still have been applied by trowelling rather than spraying. In my opinion, this is a distinction that clearly has relevance to the question of whether or not the product was, as the plaintiffs allege, inherently dangerous.

British Columbia

487 The British Columbia Workers' Compensation Board was established in 1916 with the enactment of the *Workmen's Compensation Act*, S.B.C. 1916, c. 77, the purpose of which was to "... provide for compensation to workmen for injuries sustained and industrial diseases contracted in the course of their employment".

488 Although the WCB did not recognize asbestosis as a compensable industrial disease until 1949, workers' safety with respect to asbestos and other airborne contaminants was first covered by the enactment of regulations in 1935 which provided, in part, as follows:

> 16. Gases, Fumes and Dust. -- Where workmen are exposed to injurious gases, fumes, or dust, they shall be supplied with such masks, helmets, or respirators as will afford protection.
>
> 6. Ventilation of Garages and Work-rooms. -- Adequate means of ventilation shall be provided and maintained in all garages and work-rooms for the removal of smoke, steam, gas, fumes, vapours, dust, or other impurities which are created or generated by any process carried on in such building or work-room.

489 In 1966, regulations were enacted in which, under the heading "Air Contamination", the following regulation appears:

> Control of Hazards. -- When work processes produce or are likely to produce a health hazard to workmen from the contamination of air by gases, vapours, fumes, dust, or other impurities, means shall be provided to reduce the contamination to below the recognized threshold limit value for the contaminant involved or to a point where the hazard has been reduced to conditions satisfactory to the Board.

490 By 1970, the potential hazards of asbestos were being discussed within the industrial hygiene field, and in that year the WCB created an Industrial Hygiene Department. During the 1970s, the department grew from 3 members, at its inception, to approximately 20-25 workers by 1978. The department's mandate was the assessment and prevention of industrial diseases.

491 During that time, the members of an Advisory Committee, comprised of labour and industry representatives, were considering significant revisions to the regulations. According to the testimony of Mr. Albert Riegert, who was the Director of the Industrial Hygiene Department from 1978 to 1983, the Committee considered submissions from a variety of different groups, and also considered the medical knowledge of the day, including the work of Dr. Selikoff.

492 Following public hearings and the circulation of draft regulations, the WCB rescinded the 1966 regulations and adopted new ones which became effective on May 1, 1972, approximately one year before the EPA banned, inter alia, the spray application of ACMs with an asbestos content greater than 1%.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

493 I think it important to emphasize that the WCB made these regulations fully cognizant of the asbestos controversy. Indeed, workers' concerns over the use of asbestos-containing sprayed fireproofing materials were brought to the WCB's attention in the spring of 1971, when, during the construction of the Toronto Dominion Bank Tower in downtown Vancouver, the workers staged a walk-out, protesting the application of a sprayed fibre fireproofing product. The event was widely covered by the media, and the WCB was actively involved in the situation.

494 The 1972 regulations comprised some 300 pages, divided into 38 sections. They applied to matters as diverse as guardrails, illumination, proper housekeeping, noise, proper footwear and headgear, mechanical equipment guards, welding, overhead power lines, ladders, scaffolds, floor openings, perimeter guards, excavations, hoists, rigging, cranes and painting, as well as airborne contaminants. A list of nearly 500 contaminants and 37 types of dust was appended to the regulations.

495 Asbestos concerns were dealt with through a combination of general and specific provisions. For example, the regulations specifically identified asbestos as a health hazard and harmful substance, set threshold limit values ("TLVs") for asbestos use in industries subject to the Act [*Workmen's Compensation Act*, S.B.C. 1968, c. 59], and set minimum requirements for the spray application of insulation materials containing asbestos.

496 Significantly, the 1972 regulations did not ban the spray application of asbestos-containing fireproofing materials at this time. In so doing, the WCB made a different decision from that made a year later by the EPA. Accordingly, the spray application of MK-3 in the Building was permitted by the WCB.

497 When asked about the 1972 regulations, Mr. Riegert testified that "... [they] provided the means by which the application would be sprayed with a minimal risk to the people -- to the workers involved, the applicators and the people around them".

498 With regard to the action taken by the EPA in 1973, Mr. Riegert gave the following evidence:

> Q. Were you aware of that banning in or around 1973?
>
> A. I probably was.
>
> Q. Did that prompt, that banning prompt any response from the WCB in British Columbia directly?
>
> A. There were earlier public pronouncements, if you want to call them that, coming from eastern United States which described the various precautions that had to be taken in the application of spray-on fireproofing materials containing asbestos. These were known prior to the final draft of the 1972 regulations.
>
> Q. I take it, then, that the board felt that the 1972 regulations were adequate, notwithstanding the more stringent action taken in the United States?
>
> A. That's correct.
>
> Q. Did the 1973 ban in the United States cause any increase in the attention paid to that particular product in British Columbia by the board?
>
> A. Insofar as we had more requests and inquiries placed to us by workers who either were working in proximity to asbestos materials or working with them.
>
> Q. And, of course, the board responded to those increased requests and inquiries?
>
> A. That's correct.
>
> Q. Other than that, there was no other official response?

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

A. No.

499 Following the enactment of the 1972 regulations, the WCB continued to monitor developments and research regarding asbestos hazards. In October 1972, the WCB held a Conference on Health and the Industrial Environment in Vancouver. The conference was attended by over 600 management, labour and health professional delegates. One of the subjects discussed was the treatment of asbestos hazards by regulatory bodies in the United Kingdom. Members of the Industrial Hygiene Department also attended conferences organized by American hygiene associations in order to monitor developments in that country.

500 Information from these conferences and other studies led to the enactment of new regulations in 1978. The 1978 regulations provided, in part, that:

> 35.03. When workers are exposed or likely to be exposed to asbestos, or dusts containing asbestos, such dusts shall be maintained at or below the concentrations listed in Appendix "A".
>
> 35.07. Spraying of asbestos or materials containing asbestos is prohibited unless exempted by the Board.

501 The permissible concentration level specified in App. A with respect to materials containing chrysotile asbestos is 2 fibres per millilitre of air over an 8-hour period.

502 I think it significant that the regulation prohibited the spraying of asbestos or materials containing asbestos "*unless exempted by the Board*". In other words, despite all of the information that it had gathered by that time, the WCB did not consider it necessary to enact an outright ban on the spraying of asbestos-containing materials.

503 Those regulations were still in force as of the date of this trial.

504 When asked directly about the Board's opinion of the product Monokote MK-3, so far as asbestos dust was concerned, Mr. Riegert testified as follows:

> Q. With respect to asbestos dust, did the Worker's [sic] Compensation Board consider the risk of airborne asbestos from properly applied cementitious Mono-Kote [sic] MK-3 to be a problem, or a significant problem, rather, in 1975?
>
> A. Clarification, that means after the material was applied and had set?
>
> Q. Yes.
>
> A. We did not consider it a problem until it was considerably disturbed.
>
> Q. Is that still the case?
>
> A. Yes.

505 I think it is also worth noting that during the relevant time period -- 1972 through 1975 -- the City of Vancouver Building Department did not have any regulations governing the use of asbestos-containing fireproofing materials.

506 Mr. Adrian Geraghty, who was the Structural Engineer Plan Checker in the Building Department during that period, gave the following evidence:

> Q. Was the City of Vancouver building department, to your knowledge, aware that some formulations of Grace's fireproofing product Monokote contained 12 to 13 percent asbestos?

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

A. No. But generally speaking, we were aware that most fireproofing products did contain asbestos.

Q. Was the City of Vancouver building department, to your knowledge, aware at this time of any health hazard associated with asbestos generally or as an ingredient in fireproofing?

A. Well, I wasn't aware of any hazard associated with it as an ingredient in fireproofing. I believe some hazards did exist of -- to the people who were actually making the product in Quebec, but whether that recollection was correct, I'm not sure, because it's this many years ago.

Q. Was there any prohibition on the use of asbestos-containing building materials, to your knowledge, by the City building department, City of Vancouver building department, during the period 1972 to 1975?

A. No, there wasn't.

Conclusion

507 The plaintiffs argue that compliance with the WCB regulations, or with the Vancouver City Building Code is not, per se, a defence to their claims. I agree. But, by the same token, non-compliance, in this jurisdiction at least, with an order of the EPA is not, in itself, proof of negligence or breach of contract.

508 What the history of the regulatory position in this Province provides is, I think, some important evidence to show that the product was not an inherently dangerous one. This must be so, when the statutory body charged with the protection of the health and safety of the work force, if not the general population, after careful consideration of the available information, does not enact an outright ban on the sprayed application of the product.

XIII. The Monokote Products

Introduction

509 I turn now to the evidence concerning the spray fireproofing materials produced and distributed by the Grace defendants, their response to the asbestos controversy, and their belief in the safety of MK-3.

The Evidence

510 MK-3 was one of three Monokote spray fireproofing products manufactured and sold by the Grace defendants at the relevant time, but it was the only one that contained asbestos -- 12% to 13% chrysotile asbestos.

511 At the time of its installation in the Building, MK-3 had been on the market for many years. When first introduced, it was hailed as a "breakthrough" and considered by many to be a significant improvement over other dry-sprayed fireproofing products. This was acknowledged by the plaintiffs' expert architectural witness, Alfred Roberts, who, under cross-examination by counsel for the Grace defendants, testified as follows:

Q. Is it fair to say that one of the reasons that the cementitious products such as Monokote became very popular in this timeframe is that they did not have some of the problems that sprayed fibre materials had and the need for tamping and sealing, the different methods?

A. Well, I think to architects, it was an improvement simply because it had that seemingly crust surface that kept the -- everything together. I mean -- and the others, you only had to touch them once they dried, I mean physically with your hands, and they were damaged. So to an architect, it was a breakthrough and certainly one which was welcomed at the time ...

Q. Would it be fair to say that, at the time, in the early 70's, when you considered on the one hand cementitious

11 B.C.L.R. (3d) 1, [1995] 10 W.W.R. 385, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

products versus sprayed fibre products, that you had a rough guide that cementitious products tended to have a more adhesive bond than the fluffier product?

A. Oh, very much so, but to the degree, as I say, you wouldn't know.

512 The Grace defendants assert that MK-3 was an effective fireproofing product which had performed well on several occasions. Mr. Tom Feit, who, before joining the Grace-Conn. organization was a fire-testing engineer with ULI, gave evidence about several fires that occurred during the 1960s and 1970s in buildings fireproofed by MK-3. In each case, he said, the product had done its job well, and structural damage to the buildings had been prevented.

513 Another example, closer to home, was given by Mr. Ted Ladd. He spoke of the fire that occurred during 1972 or 1973 in the Westcoast Transmission Building in Vancouver. That building is rather unique in that its floors are supported by cables rather than by steel columns. Mr. Ladd testified that he saw the building after the fire and that the MK-3 fireproofing had performed very well.

514 During the course of Mr. Ladd's testimony about the Westcoast Transmission Building fire, plaintiffs' counsel objected to the relevance of his testimony on this point saying, "[t]he utility of MK-3 is not in issue here". Nevertheless, in argument, the plaintiffs saw fit to describe MK-3 as a "very dubious product". There is no evidence to support that latterday assertion, and I find on the evidence that MK-3 was an effective fireproofing product.

515 Of course, I do not suggest that simply because MK-3 was a useful and effective product it cannot, at the same time, be dangerous and unfit for its purpose (see *Lambert v. Lastoplex Chemicals Co.*, supra).

516 Grace-Conn. acquired ownership of the MK-3 formula in 1963, and from then until 1971, it was produced in Vancouver and elsewhere in Western Canada by Grant Industries Ltd. under direct licence from Grace-Conn. In 1971, Grace-Conn.'s wholly-owned Canadian subsidiary, then known as Grace Construction Materials Ltd. ("GCM"), now Grace Canada, acquired the assets of Grant Industries Ltd., and from then until its production was stopped in the late summer of 1975, MK-3 was then produced in Western Canada by GCM.

517 During the 1960s, it became common practice to use the plenum space in buildings -- the space between a suspended false ceiling and the underside of the floor above it -- as part of the air ventilation system. Mr. Feit testified that this new development presented a problem and that Grace had to "prove" that, when subjected to moving air, MK-3 would not create dust.

518 Grace-Conn. therefore arranged to have a series of tests of MK-3 performed by independent testing laboratories. Those tests were conducted in accordance with the specification requirements of the General Services Administration ("GSA"), an agency of the United States Government, and to the standards laid down by the American Society of Testing Materials ("ASTM").

519 Mr. Feit, who was familiar with the two organizations and the testing processes, described the GSA as "the designer, specifier and owner of federal buildings, not only in Washington, D.C., but throughout the United States". He said that it had created guide specifications for a variety of building materials, including one for sprayed fireproofing, with which Mr. Feit was familiar. That specification required that a proposed fireproofing material pass a number of tests, in addition to the fire tests conducted at ULI, if it was to be used on a federal government building project.

520 The ASTM is a body of technical experts, including engineers, which produces standardized methods of testing various products, including sprayed fireproofing products.

521 The tests of fireproofing products required by the GSA in the 1960s were as follows:

522 513.0.1 Bond Strength Under Deflection;

523 513.0.2 Corrosion Resistance;

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

524 513.0.3 Bond Strength Under Impact;

525 513.0.4 Bond Strength; and

526 513.0.5 Dusting.

527 The deflection and dusting tests of MK-3 were carried out according to the standards set by the GSA. The corrosion, bond impact and bond strength tests were also carried out according to GSA standards and, as well, those of the ASTM. The results of the tests were as follows:

1) Deflection:

A steel deck sprayed with MK-3 was deflected 1/120 of the span or 1.2 inches, without any cracking, flaking or delamination of the applied MK-3.

2) Bond Impact:

A 60 pound weight was dropped from 4 foot height onto a panel to which MK-3 had been applied. The panel was then closely examined with a magnifying glass and no trace of flaking, cracking or delamination of the MK material could be found.

3) Bond Strength:

The average bond strength of MK-3 on uncoated steel was 1131 pounds per square foot ("PSF"), on shop coated steel 1312 PSF; and on galvanized steel 1161 PSF. The GSA standard for bond strength required that the bond strength be 20 times the weight of the material. The bond strength of MK-3 was well over double that standard.

4) Dusting:

There was "no measurable loss of weight" from MK-3 after running an air stream over it for 87 hours at 104.8 mph. That is equal to over 9000 feet per minute, whereas the GSA air erosion standard was based on air flows of only 800 feet per minute. The GSA standard also allows weight loss of up to .025 grams per square foot.

528 The dusting test was conducted by Boyle Engineering in April 1964. It satisfied Grace's concern and, in Mr. Feit's words, "proved beyond doubt that Monokote was, indeed, an extremely durable material and able to withstand, from a dusting aspect, as tested better than any other product on the market".

529 In 1968, the California Department of Health carried out tests during the application of MK-3 in a high school. The results of the air samples collected at that time showed that the particle counts at the time of application were below the threshold limits or levels recommended by the American Conference of Governmental Industrial Hygienists. Mr. Tom Egan, who was the National Fireproofing Products Manager of Grace-Conn. from 1968 to 1971, testified that this was another piece of evidence that reinforced Grace-Conn.'s belief that MK-3 was a safe product.

530 In January 1969, Grace-Conn. formed a Construction Products Division ("CPD") and Mr. Rodney Vining became its first President, a position he held until 1986. The CPD then handled several hundred products, including roofing, insulation, and waterproofing materials, horticultural products, concrete and chemical products, as well as fireproofing materials -- the most important of which was Monokote.

531 When Mr. Vining became President of the CPD, there were two basic types of fireproofing products on the market. One was a sprayed fibre material and the other was Grace's product, MK-3. The sprayed fibre material, which was the "dominant" product in the market, contained about 80% to 85% fibre content, predominantly asbestos fibres. MK-3, on the

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

other hand, contained roughly 12% to 13% asbestos fibres, approximately 58% gypsum (as a bonding agent), approximately 29% vermiculite, and a small amount of Duponal.

532 The various components of MK-3 were mixed together at a plant, then bagged and shipped to the job sites. There, the bags were emptied into a hopper and mixed with a stipulated quantity of water. This formed a "slurry" that was then pumped to wherever it was to be applied, as high as 50 or 60 stories or more. At the far end, the material came out of a nozzle and was "hosed" onto the building structure.

533 The other sprayed fibre material was also mixed at a plant and put into bags. But at the job site the process was quite different. There, the bags would be emptied into hoppers, stirred around to loosen the material, and then pumped dry to the application point. Then, as it came out of the hose nozzle, it was propelled through a "halo" of water to wet it down and applied to the building structure.

534 Mr. Vining testified that he saw the other fibre product applied once or twice. He said that he remembers standing some 50 or 60 feet away from the application point and seeing nothing but a white cloud as the material came out of the hose, through the water spray and onto the building. He compared this to the manner in which Monokote was sprayed, and said that there were "real differences" between the two products. His evidence on this point was consistent with all of the other evidence I heard about the performance characteristics of the two different products.

535 Notwithstanding the difference between the two products and application processes, the plaintiffs reject the validity of the "cementitious" description applied to MK-3. They go so far as to suggest that the use of that term in Grace's promotional material is misleading, in that MK-3 did not form into "cement" and lock in the fibres.

536 That argument is not supported by the evidence. The "cementitious" nature of MK-3 was accepted by numerous bodies, two major testing laboratories, ULI and ULC, as distinguishing MK-3 from the dry-sprayed products.

537 That distinction was also noted and accepted by the WCB when it conducted inspections of the Harbour Centre Building during its construction in the first half of the 1970s. Mr. Albert Riegert, a former director of the Research and Standards Department of the Occupational Safety and Health Division of the WCB, whose evidence on examination for discovery was read into the record, testified that:

> The inspector was reasonably satisfied that the cementitious material would not present a hazard as compared to the very fluffy Limpet applied material.

538 Based on all of the evidence, I find that the description of MK-3 as a "cementitious" product is a valid one.

539 In 1968, or thereabouts, Mr. Egan became aware of the concerns then being expressed by Dr. Selikoff and others about the use of asbestos-containing spray fireproofing materials. However, according to Mr. Egan and other Grace witnesses, the projects described by Dr. Selikoff involved the use of a dry-sprayed fibre product, not Monokote.

540 One of the first things that Mr. Vining can recall about the asbestos controversy is reading the Brodeur articles about Dr. Selikoff's studies. While he, too, felt that Dr. Selikoff's findings related to other sprayed asbestos products, and not to Monokote, he, together with Mr. Egan and other Grace officials, became afraid that even a cementitious product such as MK-3 would be "tarred with the same brush". Therefore, when some of CPD's employees came to him in the first half of 1969, and told him that they wanted to develop an asbestos-free fireproofing product, Mr. Vining gave them the go-ahead.

541 When asked about that decision, Mr. Vining testified:

> We had two objectives at that point in time. Our fellows were worried that we would get tarred or in some way get involved with the problems the spray asbestos fireproofing was having in the marketplace. They felt, given that possibility, that they needed to develop a non-asbestos Monokote to offer along with our Monokote 3. They were concerned about this, even though it was an entirely different product.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> Secondly, our guys saw an opportunity to significantly increase the market share of non-asbestos product and offering both of those. Particularly in the Midwest and the East. That was our second objective behind doing that.

542 In a memorandum dated December 1, 1969, Mr. Egan wrote:

> Knowing the building pressure against the use of asbestos in sprayed fireproofing, particularly in the New York, Philadelphia area, and concern spreading rapidly throughout the country, there are two prime reasons why we should get asbestos out of Mono-Kote [sic]. They are:
>
> 1. We are going to get included in the indictment since we have asbestos in Mono-Kote [sic].
>
> 2. Mono-Kote [sic] without asbestos would give us a tremendous sales increase at once.
>
> Also, we have an *ethical obligation* to get it out. (emphasis added)

543 The plaintiffs have seized upon those words "ethical obligation" as evidence that, contrary to Grace-Conn.'s public statements and the testimony given by its representatives during this trial, at least one senior employee of Grace-Conn. had serious concerns at that time about the safety of MK-3.

544 When asked at trial to explain what he meant by the words "an ethical obligation to get it out", Mr. Egan testified that:

> As I have stated previously, Dr. Selikoff's premise more or less was that raw asbestos, the danger, and the evidence showed that people that worked with raw asbestos daily for given periods of time per day and being exposed to it over a relative long period of time were in great danger. Their health was in great danger, and the one area, since the formulated product we felt had such a small amount, it was mixed in with the gypsum and the vermiculite, when the gypsum got hard and set it tends to lock in or encapsulate everything that was in there. It kept it all in place, that any amounts of asbestos were nil, they weren't there, or very, very minimal at best and if that, and the only place that there was exposure to any of our people was in the mixing plant where they made Monokote, where -- and recognized, Grace purchased asbestos from outside vendors, people that mined and refined asbestos.
>
> Grace mined and refined its own vermiculite. They bought gypsum from the gypsum companies, they bought asbestos from the asbestos miner and mills, and the people in our plants would take the gypsum, the vermiculite that they expanded in the plants and the asbestos that they mixed and dumped that all together and blended it and there was -- their exposure to raw asbestos, and I felt in the strongest term as possible to say that we should not, we can get away from this. We have an ethical obligation to -- I used the term ethical obligation to get it out.

545 During cross-examination, Mr. Roberts attempted to show that Mr. Egan was dissembling, and that his concerns were much broader than he would admit. But Mr. Egan remained steadfast in his position. He stated:

> I believe I answered several times to the effect that the only place that I knew Grace employees handled pure asbestos fibre, which was the problem identified directly by Dr. Selikoff and others, was in our manufacturing plants where the purchased asbestos bags were opened and mixed in with the gypsum and the vermiculite to make MK-3, and that was a direct exposure to the mineral that Dr. Selikoff was alerting us was a danger, pure, raw asbestos.

546 I found Mr. Egan to be a truthful and straightforward witness and I accept his explanation.

547 Under Mr. Vining's supervision, Grace-Conn.'s CPD division embarked upon a "two-pronged approach" to the problem. The first approach was to develop a new, non-asbestos product, one that would be equal in all other respects to MK-3.

548 By mid-1970, Grace had developed a non-asbestos product, but it failed to pass a fire test. From that point on, to use his words, Mr. Vining "rode hard" to make up for lost time. An improved product was fire tested in early 1971 and achieved a number of rating approvals, but not to the extent of equivalency with MK-3. That new product, designated MK-4, was

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

introduced to the market in May 1971, while work continued on the development of a fully equivalent substitute for MK-3.

549 In October 1972, MK-5 was announced. It had achieved all of the fire ratings held by MK-3.

550 When asked about discussions with other company people, during the time period of 1969-1970, as to whether or not MK-3 was a safe product from a health standpoint, Mr. Vining testified that:

> We believed we had a safe product, but we didn't have enough hard data to be sure of that, to be able to talk to people who would raise questions on the subject.

551 Notwithstanding the search for and achievement of a non-asbestos product with the same fire ratings as MK-3, every one of the senior officers and employees of both Grace companies who testified at this trial maintained their continuing belief that MK-3 was and still is a safe product.

552 In 1970, Grace embarked upon the second "prong" of its approach to the asbestos problem, namely, a testing programme to confirm their belief that their product was safe.

553 Confident that tests would show that MK-3 was different from the sprayed fibre products, Grace-Conn. retained Dr. Selikoff -- the person at the forefront of the asbestos controversy -- to conduct tests on MK-3 in his laboratory at Mt. Sinai Hospital. However, Grace-Conn. was later informed by the hospital that the testing could not be scheduled. In June 1970, Mr. Egan wrote to Dr. Selikoff extending a further invitation to test their product, but it was not accepted.

554 Unable to secure the services of Dr. Selikoff, Grace-Conn. retained other independent sources to conduct a number of tests. These included:

555 1. The Tabershaw Cooper tests (1970), designed to test airborne dust levels during the spray application of MK-3. A plenum study was also conducted, to compare the air in the building with the outside ambient air. Of the thirty samples taken, all were below California standards of the time, and only one was above a more stringent standard proposed by the ACGIH. The plenum study revealed that the concentrations of airborne asbestos fibres in the building were at "the low end" of the range of concentrations found in the outside air.

556 2. The Valentine Fisher test (1970), which examined the levels of airborne asbestos fibres during renovations in the plenum of a building containing MK-3. The results showed that no asbestos particles were found, which was thought to be the result of purging of the air.

557 3. The Bowser Morner Test (1970), which examined the potential for erosion of MK-3 when subjected to a high velocity airstream. Here a negligible amount of dust was found in the collection filters, indistinguishable from dust levels in the ambient air.

558 4. The Werby Laboratory analyses (1970), which examined samples taken by Grace-Conn. and determined the levels of airborne asbestos fibres during mixing and application. The results were below both actual and (more stringent) proposed standards by the ACGIH. The lab also compared the application of sprayed fibre fireproofing with MK-3 and found that fibre counts with the spray fibre fireproofing were higher, and in one case above the ACGIH standard.

559 5. The Oregon State Board of Health Tests (1970), which were conducted to determine the level of exposure workmen were subjected to during the application of MK-3. The results showed that the TLVs were many times lower than the current standard.

560 6. The State of Washington Test (1972), which conducted air sampling tests during the application of MK-3 in a building. The results again showed very low fibre release, including no release during the clean up of dry overspray.

561 The plaintiffs dispute the findings of all of those tests. They argue, for example, that many of them are unreliable

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

because the samples obtained were analyzed by using an optical phase contrast microscope, rather than a transmission electron microscope. I do not accept that criticism as valid. Much evidence was led at trial about this matter and I am satisfied that at that time, and indeed today, the phase contrast microscope is the appropriate tool to use when analyzing the data in order to determine whether there exists a hazard to health due to the presence of asbestos fibres. Dr. Gordon Bragg, whose evidence I will discuss in more detail later, stated that while the transmission electron microscope reveals what type of fibre is in the air, the phase contrast optical method is:

> ... the correct tool to answer the question, is there a health hazard or is there a procedure which we should use to fulfil our regulatory responsibility ...

562 I also note that the phase contrast microscope is still used by the WCB, and that it was used by the plaintiffs' own consultants for the purposes of their report on asbestos in the Building.

563 I am satisfied that, taken cumulatively, the results of those tests support Grace's belief that MK-3 was safe, and that a valid distinction could be drawn between their product and other spray fibre products lacking its "cementitious" qualities. Grace's reliance on those test results, conducted as they were by independent sources, was in my opinion entirely reasonable.

564 However, the results of those tests do not, in themselves, answer the legal question before this Court concerning the safety of MK-3.

565 In further support of their belief that MK-3 was safe, the Grace defendants point to the fact that the WCB had not, at the relevant time, classified the product, or the method of its application, as hazardous.

566 Mr. Jim McKague, who was the General Manager and a Vice-President of Grace Canada during the time when MK-3 was sold and installed in the Building, testified that he thought then that MK-3 was safe, and that he believes that today. He testified that he would not have continued to sell MK-3 if he had believed it to be hazardous. He said that the EPA's prohibition of the sprayed application of MK-3 was not of concern to him because he had seen no evidence of MK-3 creating any hazards, and "... was not aware of anybody in Canada or any testing authority that felt that it was hazardous".

567 Mr. McKague testified that in the 1970s he was aware of testing of MK-3 by Workers' Compensation Boards in three provinces, including British Columbia, and that none of them had indicated that MK-3 was hazardous. He relied on the fact that, during the 1973 to 1975 period, no Canadian regulatory authority, of which he was aware, showed any intention of following the EPA regulation by restricting or prohibiting the use of sprayed asbestos-containing materials. He said:

> Q. Mr. McKague, did you -- you've indicated that you knew in 1973 that the EPA had issued a regulation that prohibited the spraying of the asbestos-containing Monokote MK-3?
>
> A. Yes.
>
> Q. And you knew that that -- at that point that Grace-Conn. ceased manufacturing MK-3?
>
> A. Yes, I did.
>
> Q. Now, did that action, EPA's action in itself, give you concern about hazards as opposed to I believe ability to manufacture?
>
> A. No, I think I said before that I was not concerned about any hazards. I was not aware of any hazards and I was not aware of anybody in Canada or any testing authority or any government authority that felt it was hazardous.
>
> Q. Would you have continued to sell MK-3 if you believed it to be hazardous?
>
> A. Certainly not.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> Q. Now, from the time that you made the decision to continue, or at least from the time of the EPA ban in 1973 and you continued in Canada to manufacture MK-3, to the time of your retirement in 1979 with Grace Canada, at any point during that period of time did you come to a different conclusion? Did you come to a conclusion that there were safety hazards associated with MK-3?
>
> A. No, I still feel the same way about the safety and the non-hazardous [sic] of MK-3. At no time while I was with Grace did I have any reason to change my opinion in that respect. I didn't change it up to the time I retired, and as far as I'm concerned, I still feel the same way today.

568 The plaintiffs have argued that Grace-Conn. should have conducted other tests, ones which would have examined the release of asbestos fibres from MK-3 during the demolition of a building in which it had been installed. They place great emphasis on the fact that the EPA expressed its concern about the potential release of asbestos fibres on demolition in a letter to Grace-Conn., dated July 31, 1972, in which it advised as follows:

> Asbestos emissions as a result of use of asbestos-containing fireproofing materials were extensively studied prior to our decision that banning spraying of asbestos-containing materials was necessary to protect the public health. Such emissions may occur during spraying, cleanup and disposal of overspray, and demolition of the building, and control in each of these operations is unsatisfactory. Thus, we feel the prohibition action is necessary. The building is a source when sprayed and when demolished, and one well recognized method of air pollution control is substitution of material that reduces potential emissions of the substance in question when such substitution is feasible.

569 Assuming they could have done so, I do not think that anything turns, in this case at least, on the fact Grace-Conn. did not conduct tests to determine the extent of fibre release when a building is demolished. It is clear that when an asbestos-containing building is demolished, stringent safety precautions of the nature described during this trial, and mandated by the regulatory authorities, must be taken.

570 In any event, that is not why the plaintiffs decided to have the fireproofing material removed from the Building. They do not say that they decided to have it removed now because they, or some future owner, will have to take special precautions when the Building is torn down. They allege that they decided to have it removed because, from the time of its installation in the Building, asbestos fibres were continually released from the material, and because further releases occurred whenever the material was disturbed in the ordinary course of building maintenance and renovation.

XIV. Asbestos in Buildings

571 Dr. Frank, whose evidence concerning the asbestos-related diseases I canvassed earlier, is of the opinion that in any building containing asbestos-containing materials there exists a risk of exposure to asbestos fibres in sufficient quantity to cause disease. He testified that:

> ... there clearly is a risk, it depends on how much exposure and for how long. Housewives who clean their husband's [sic] clothes basically only had peak exposure, maybe once a week when they cleaned clothes. A similar situation could occur in buildings where from time to time renovations go on or dropped ceilings get taken down or asbestos gets blown around the building.

He also said that:

> Asbestos has been widely used in construction, and sprayed-on asbestos-containing materials are of particular concern because of their friability
>
> .....
>
> Other asbestos-containing materials are also of significance, but those materials that have been sprayed on in the past generally have the highest propensity for becoming airborne and subsequently inhaled or ingested
>
> .....

> It is the friable material that could be expected to contribute most to the issue of peak exposure, and for maintenance workers in buildings there is a particular risk ... For building occupants and visitors, the risk, while less, is still a factor whenever asbestos is present and could enter the air.

572 However, Dr. Frank acknowledged that there are no studies to support his view and that:

> ... all of the other evidence which is circumstantial, if you will, from what we know about every other setting, would lead one to think that there are risks to people in buildings, though the risk will be less than in other settings.

573 In his Report, under the heading "The Case for Removal", Dr. Frank wrote:

> There are well-articulated public health principles that can be referenced with regard to the protection of individuals, when considering the case for removal of asbestos from buildings. Because of the propensity for asbestos to cause disease, especially cancerous diseases, it would be prudent from a public health perspective to eliminate the presence of asbestos whenever possible. The practical aspects of any removal program will be dictated by a variety of factors, including the types and amounts of asbestos present, its friability, its potential or current evidence of deterioration, as well as other factors.
>
> It has been suggested that removal puts individuals at risk and that this favours leaving asbestos in place. Improper removal might well put individuals at risk for the development of disease, but properly conducted removal should not pose any risk to the workers performing the removal or the occupants of a building, and will once and for all eliminate any concern or future problem related to asbestos, once it has been removed. There are many documentable cases of proper removal technique, along with examples to the contrary.
>
> It is not a reasonable standard to suggest that one must wait for evidence of disease related to building exposure in others than maintenance workers, where such evidence already exists, because such evidence will be difficult to acquire, and in many groups, the latency period has not been met for many individuals. *Any one building may not be the site for the development of a case of asbestos-related disease, but in the aggregate, it is clear that with increased asbestos exposure, following the principles of both dose-response and basic carcinogenesis theory, that additional cases of disease would be expected to occur, and that removal of asbestos from buildings is dictated under sound public health practice for the protection and well-being of people.* (emphasis added)

574 Dr. Elmes also gave evidence about the risk to building occupants of exposure to asbestos. He stated that at the time the MK-3 spray fireproofing material was installed in the Building, there were no studies to indicate that an occupant of a building had contracted any of the asbestos-related diseases due to the presence of an ACM. He testified that:

> ... there might be boiler insulation in the building, there might be cementitious fireproofing, there might be cementitious ceiling material, and so on, and there might even be the dry spray material, limpet type spray material up above the ceiling, suspended ceilings, and so on, and this -- it didn't matter what, you went around and looked in the building and said, "Oh, goodness me. There is a lot of asbestos in this building. The levels are going to be high." It didn't work out that way. *They are almost universally low unless there was some recurring or current damage to the material in the building.* (emphasis added)

575 When asked if these types of levels in a building, particularly if they consist only of chrysotile asbestos fibres, present a risk to the health of the occupants of the building, Dr. Elmes stated:

> No, I -- in my opinion right now they don't present any risk at all. But if you simply look at the arithmetic of it that this is three or four orders of magnitude, that's a thousand to 10,000 times lower exposure level than, for instance, my insulation workers were getting, and if there is a linear dose response relationship in this then correspondingly whereas my people had a 15, 17 percent risk of getting mesothelioma or a 20 percent risk of getting lung cancer, these people have a zero zero something risk of getting either.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> Q. And what about the latency period?
>
> A. The latency period would be very long. Probably longer than the lifetime, because the lower the dose the longer the latency period, and they might have to wait 300 or more years, or in -- we did this arithmetic in one case, I remember, and we got it out to 10,000 years. But let's say a thousand years before they would get an appreciable risk of either cancer working in the buildings.
>
> Q. Not something that a epidemiologist would worry about if it was that length out in the normal?
>
> A. No, no.

576 On the subject of air sampling in buildings, Dr. Elmes testified that the first paper concerning the analysis of air in public buildings appeared in 1969. Its authors, Byrom, Hodgson and Holmes, concluded that the exposure levels in buildings were extremely low in comparison to exposure levels in industry and did not constitute a risk. However, Dr. Elmes acknowledged that the methodology employed for the purposes of that study was "pretty primitive technology". He said that:

> They were using optical microscopes, and their fibre counts looked bad by our present day standards. They were of the order of .1 or under .1 fibres per cc -- .01 fibres per cc but they were using optical methods, and they were counting a lot of fibres that we now suspect must have been not asbestos fibres ... But they nevertheless concluded that by comparison with the levels in industry these were so low that they didn't constitute a risk.

577 That conclusion, Dr. Elmes agreed, was not generally accepted by the medical community at the time. There were people, he said, who believed that the authors were too closely associated with the asbestos industry. However, he maintained that the scientists who were working in that field and who knew the authors did accept their findings.

578 Dr. Elmes also testified that, right up to the end of 1975, there was no evidence of an individual who had been exposed to asbestos fibres at the levels experienced by a building occupant contracting any one of the asbestos-related diseases, including mesothelioma. In fact, he said, he is unaware of any evidence at the present time of that happening.

579 In 1975, Dr. William Nicholson, one of Dr. Selikoff's colleagues at the Mount Sinai Hospital, was commissioned by the EPA to conduct a study of asbestos levels found in the ambient air in buildings. He compared the outside ambient air with the air in buildings in which asbestos- containing fireproofing material had been applied. Dr. Elmes described his Report as one of the most important papers that has been published on this subject.

580 Dr. Nicholson's study shows that counts of asbestos fibres in the air in buildings in which *cementitious* asbestos-containing material was used were lower or equivalent to the counts found in the outside air. It also showed that some of the buildings in which dry sprayed fireproofing or insulation materials had been applied had slightly raised fibre counts.

581 It is, however, important to note that, by "cementitious", Dr. Nicholson was referring to products containing a Portland cement component. MK-3 does not. It contains gypsum as the binding agent.

582 As to the current state of knowledge, in my opinion, the evidence given by all of the medical experts, with the exception of Dr. Frank, clearly establishes that the type of exposure encountered in buildings is far too low to increase the risk of contracting any of the asbestos-related diseases.

583 Perhaps the most importance evidence in this area was given by Dr. Gordon Bragg. He is a mechanical engineer, licensed to practise in the provinces of Ontario and Alberta. During his professional career, he has been involved in a number of engineering projects, including working as a consultant on asbestos questions for the Ontario Ministry of Labour and Ministry of Health. During his years as a consultant, Dr. Bragg gave advice to the government concerning proposed legislation and regulations relating to asbestos. He also visited plants and factories to conduct fibre level measurements and to advise the owners on the control of asbestos.

584 Dr. Bragg is currently a full professor of mechanical engineering at the University of Waterloo. Several of the senior

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

or graduate level courses taught by Dr. Bragg have involved the study of asbestos-related issues. He has published approximately 50 papers in refereed journals, another 40 in contract reports or as guidance documents, and has been involved in the production of four books. Of these publications, about half of each category deal with asbestos-related matters. He has also acted as a peer reviewer for a number of refereed journals and several other publications.

585 Dr. Bragg has taken literally thousands of air samples relating to asbestos. He has observed the manufacture and the application of ACMs, including cementitious fireproofing, and he has evaluated ACMs in approximately one hundred buildings, including schools, homes, and office buildings.

586 Dr. Bragg was qualified to give expert evidence concerning the measurement and behaviour of airborne asbestos fibres released from ACMs in buildings. He was also qualified to give expert evidence as to the sources of asbestos fibres generally found in the ambient air.

587 Dr. Bragg spoke of the levels of asbestos fibres found in the ambient air, the scientific term for which is the "background level". He noted that the standards for exposure to asbestos set by the B.C. Workers' Compensation Board are approximately 2,000 times what is expected to be present in the ambient air. He said that these permissible exposure levels ("PELs") are comparable to those established in the other provinces and in a majority of the developed countries as being an "appropriate response" to the risks of asbestos exposure. Dr. Bragg noted that PELs set by the Occupational Safety and Health Administration in the United States were slightly lower than those in B.C. This, he said, is because the U.S. legislation requires that the lowest level possible must be achieved.

588 Dr. Bragg is familiar with a great many studies that compare the indoor asbestos levels of buildings containing ACMs with the outdoor level around the same buildings. He said that, in the great majority of those studies, it was concluded that there was no significant difference between indoor and outdoor levels.

589 Dr. Bragg noted that these findings applied whether or not the ACM was in good condition, and that they took into account the possibility of repairs being performed in the building.

590 Dr. Bragg stated that, as a result of the findings that indoor and outdoor levels are comparable, it is difficult to ascertain whether asbestos detected inside building surfaces originated from the ACM or from other sources in the outside ambient air. He said:

> Not only is it not possible in general to determine whether individual fibres have come that way, but if we are talking about very small fibres, it's probable, certainly it's possible that significant levels on surfaces indoors have come from the settling of outdoor origin asbestos. So that, for example, although I have not seen data ... surface level fibre concentrations would be found in buildings that don't contain asbestos and never did.

591 When asked whether the findings about indoor and outdoor levels applied to buildings containing cementitious fireproofing, and specifically to buildings containing MK-3, Dr. Bragg gave the following evidence:

> A. As I understand it, MK-3 consists of about 10 per cent chrysotile and some vermiculite and about 60 per cent gypsum.
>
> Q. I'll give you some assumptions to base this on. Assume that the product consists of approximately 60 per cent gypsum and approximately 30 per cent vermiculite and approximately 10 to 15 per cent asbestos.
>
> A. And it is a wet-sprayed product?
>
> Q. Yes.
>
> A. Under these conditions, this set of conclusions I spoke to would certainly apply, without question. This is particularly true because the essence of an emission, anything that might cause an emission, is a disturbance to an asbestos-containing material and since such a material which is wet sprayed and which has gypsum as a binder or

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

cement, is going to be fairly rigid. It would be considerably less susceptible to a disturbance or to damage than, say, a dry-sprayed product. So it would certainly be applicable in this case.

Q. Now, Dr. Bragg, what in your opinion causes asbestos fibres in ACM to become airborne at all?

A. In one word, a disturbance is necessary. To explain what I mean by that, I think it's appropriate and useful to break the disturbance which might cause an emission into a three-step process and it clarifies a number of things that help to understand why these levels are as they are.

The first thing we need to do if we are to get an airborne fibre of importance into the air, is break up the matrix of the product. A matrix is a mixture of things and in this case, vermiculite, gypsum and asbestos. We have got to break that up and create, broken away from the material, something small enough to get into the air for any significant amount of time and this breaking up or grinding or processing, scientifically it's called comminution, it's the science of making small things out of large things, requires a fair focused force of some sort.

The second stage that's required is that, assuming that that's being created, we need to move that small particle and again I would suggest to you that the particles that are of interest are so small that we can't see them. If we can see a particle, it's too large to be taken in, to be inhaled or respired, and these very small particles are held on to solid surfaces with some considerable force. Something that's unusual in our day-to-day understanding. We need that force to bring it off the solid surface.

I might give an example of what's happening here, if you think of the dust on your car, that particulate which is literally hundreds of times larger than that that's of concern to us here, stays on your car in the presence of driving in high velocity, it even stays on your car, or the smaller ones do, in the presence of raindrops and things of that nature. They're held on there by electrostatic forces or things which are similar to electrostatic forces.

These small particles [which are] of interest to us are many times smaller and held on many more times strongly. Again, to overcome this, we need a disturbance, a focused force. That's the second thing that needs to happen.

The third thing that needs to happen is we need to get this particle away from the surface and into an area where it's sampled or collected or something like that, and this is -- that happens very easily. This is just the natural room air current and outdoors the natural wind. This will indeed happen very easily if the first two occur. So to overcome particularly these first two requirements, to get first a particle and then to get it into the air, we need a disturbance of some sort.

Q. I now have a new explanation to my wife about my dirty cars. But moving to the question of getting the product, getting the fibres off the ACM, would an air stream over the ACM be sufficient to release fibres from the matrix?

A. Not any normal air stream that could be contemplated in a building, would not be sufficient to do this. This has been studied fairly extensively by myself and there's a number of other studies that suggest that normal air streams of the type you find in buildings simply are not sufficient to bring these respirable particles into the air. This is the opposite of what's happening with visible debris where everyone, of course, is familiar that the large non-inhalable debris will move relatively easily through mechanisms of this sort.

Q. What about vibration that occurs in a building, either from the outside, from external sources or indeed from the operation of equipment or some other internal source in the building?

A. Normal forces of -- the vibration forces of the type we find in buildings, motors vibration, equipment moving, things of this sort, is not sufficiently focused to overcome these forces for the small respirable particles. Again, this is not the condition for large visible debris. Everyone is, of course, aware that that larger material can, of course, be dislodged by mechanisms of that sort.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

Q. What force then would be necessary, in more detail, to release an asbestos fibre from the matrix?

A. Again, we are looking for it to be of a magnitude and sufficiently focused for it to occur, that the best example is sanding. Sanding the many small hard particles on sandpaper cause small focused forces that are very effective, actually creating the dispersal mechanisms or the creation of dispersal mechanisms I'm speaking of. Even something like, for example, drilling might conceivably produce a measurable level while it was occurring in the immediate vicinity of the drill. Sawing would be another example where indeed you might get a measurable level in the vicinity of the event.

Q. What about hitting the fireproofing?

A. There have been a number of studies of this, one of which was by Mr. Ewing, and it suggests that is not necessarily so. That something like a hammer or something is not necessarily sufficiently focused as to certain -- as to give a level which is measurable above this indoor background that I spoke of earlier.

Q. Could you turn to tab 6 in this brief of material before you, Dr. Bragg? You mentioned Mr. Ewing and there is a paper by Mr. Ewing at tab 6. Are you familiar with that paper?

A. Yes.

Q. And does that paper bear on the discussion at present concerning impact on ACM?

A. It is one instance of the studies I mentioned, yes.

Q. And with respect to the questions that I originally posed, hitting fireproofing with some object, does the paper reach a conclusion concerning that?

A. Yes, it does. Under "Results", if I may quote, it says that "Asbestos structures" and Mr. Ewing is using a different measurement of the asbestos present than I was speaking of, however, the general conclusion remains: "Asbestos structures were not detected above background levels in air samples collected during the impact test and during two hours immediately following the impact activities" ...

592 During cross-examination, Mr. Williamson challenged Dr. Bragg's suggestion that there must be a disturbance before fibre will become airborne. Specifically, Mr. Williamson put to Dr. Bragg the comments contained in two EPA documents suggesting that as ACM deteriorates with age, it releases fibres without any sort of disturbance. Dr. Bragg was adamant in his rejection of this conclusion. He stated:

> ... this is an example of the sort of thing we frequently see in regulatory and guidance documents. These are not scientific documents, as you have heard me speak yesterday. This is typical of the sort of thing that has been derivative for the EPA documents. As I pointed out, the scientific basis for these -- for these conclusions in the main is nil, they are without foundation. There is ample proof that the majority of these statements are contrary to current findings and I would dispute the majority of them.

593 He further noted that regulatory agencies often err on the side of safety which, although a laudable objective in theory, may in practice result in a misdirection of resources to places where there is no significant risk.

594 In further response to Mr. Williamson's cross-examination on the release of fibre absent any kind of disturbance, Dr. Bragg made an important point relating to deterioration and airborne asbestos fibre. He stressed that the presence of debris does not necessarily indicate the presence of measurable levels of fibre. He noted that there are two kinds of dislodging: a dislodging of a chunk of ACM, and a further dislodging of fibres from that chunk. He stressed that the first does not necessarily lead to the second. On this point he stated:

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

> I would agree that the evidence is quite consistent that debris below many of these products occurs on a quite frequent basis. Certainly we know that it has occurred in a very significant number of the hundreds of buildings where we have done air sampling and we know as a result that *the presence of this debris is entirely consistent with no measurable levels of asbestos fibre above the background levels* ... (emphasis added)

595 Dr. Bragg also noted that the important distinction between dry-sprayed and cementitious materials is often not made, the latter being less likely to be disturbed over time.

596 Dr. Bragg was asked to explain what happens to the fibres that have been emitted following a disturbance of sufficient force. He stated that in any room, human movement, forced ventilation or even minute temperature differences will cause dilution. The result is that the number of fibres per cc of air goes down as more air becomes involved. Following dilution, ventilation has the greatest impact on the emission of asbestos fibres. Dr. Bragg stated that even in relatively tightly sealed office buildings, there is air entering and air leaving the building in equal proportion. This occurrence is quantified by a phrase called "air change per hour". Dr. Bragg stated that two air changes per hour would be expected not only in an individual room but throughout the entire building. He stated that two changes per hour is a typical value, one that is used by the U.S. EPA as a minimum.

597 When asked whether, over time, there could be a build-up of asbestos fibres in buildings containing ACMs, he replied:

> My explanation, I hope, has indicated that there is no reason to expect one and we have again hundreds of buildings that have been inspected, both of varying ages and of varying types and there is neither in the field nor on the basis of this type of description, any evidence of buildup at all. *There is, to my knowledge, no such thing as any building that's ever been demonstrated to have a consistently elevated level that's significantly above outdoor ambient.* (emphasis added)

598 In short, Dr. Bragg's evidence confirms the opinions expressed by the medical experts called by the Grace defendants that there is no increased risk to workers or occupants from the low level of exposure to asbestos that one may expect to encounter in public buildings generally.

XV. The Alleged Contamination of the Building

599 I turn now to a consideration of the evidence regarding the Spencer Building itself, and whether the plaintiffs have demonstrated that, contrary to the expert evidence about buildings in general, it was "contaminated" by MK-3 to the extent that asbestos fibres posed a substantial danger to the health of its workers and occupants.

600 In deciding this question I will focus, primarily, on two key reports: the May 2, 1987 report prepared by the plaintiffs' consultants, Pinchin-Harris & Associates Ltd. (and the events leading up to the release of that report), and a later report commissioned by the plaintiffs and prepared by Mr. William Ewing some time after the removal project had begun.

The Pinchin-Harris Report

601 Following the shutdown of the work site on March 30, 1987, Jon Hall sought the advice of Pinchin-Harris & Associates. They were (and, under the name Pinchin Harris Holland, continue to be) a firm specializing in the field of asbestos containment and removal. Their practice was, as a general rule, to first conduct a survey in order to establish or confirm the presence of asbestos-containing materials and ascertain the condition of any such materials. Depending upon those findings, they would then make recommendations and specifications for the control or containment of such materials or oversee its removal from the building.

602 Mr. John Holland, a professional engineer with many years of experience in the field, was the person assigned to supervise the work done by Pinchin-Harris in connection with the Building.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

603 As stated in the introduction to their final report, Pinchin-Harris were initially retained to establish the presence and extent of asbestos-containing materials within the third and fourth floors of the Building (those intended for occupancy by the DFO), to survey and establish the extent and amount of asbestos-containing materials in the balance of the Building and to make recommendations with regard to the control of that material.

604 Upon being consulted by Mr. Hall, Pinchin-Harris ordered a test of three samples of fireproofing, the results of which were released on April 2, 1987. The tests revealed the presence of chrysotile asbestos in excess of 10%. Pinchin-Harris then began work on a report which would make recommendations for a course of action. That report was completed on May 2, 1987.

605 The plaintiffs, however, did not wait for that report before taking action. The decision to remove the asbestos -- at least from the third and fourth floors -- was made on the same day the test samples revealed the presence of asbestos, without the benefit of the recommendations contained in the May 2, 1987 report.

606 In a letter to the DPW, dated April 2, 1987, the plaintiffs committed themselves to removal, stating:

> The Landlord will live up to its commitment and remove the contaminated material from both the 3rd and 4th floors.

607 Action on this matter continued at a remarkably swift pace. The following day, Pinchin-Harris was retained to design the scope of an asbestos removal programme and to carry out site inspections and air sampling procedures during the removal process. By April 8, 1987, a call for bids to complete the work had closed.

608 According to the plaintiffs, the April 2 decision was made "after taking advice from Pinchin-Harris". The value of any such advice would have been minimal at best, given that the test results had only just been received and work on the report had just begun. Indeed, Pinchin-Harris had only inspected the site once by that time, and they went on to inspect it five more times later that month.

609 On April 9, 1987, Mr. Rainer Hackert, the President of Polaris (Canada), wrote to a Mr. Rick Atkinson of Sears Canada advising that:

> On March 31st, 1987 a routine inspection by Workers Compensation Board of B.C. [sic] revealed the potential of small amounts of Asbestos in the fire proofing on the third and fourth floors of [the Building]. We have previously undertaken a testing programme ourselves which had proved negative and therefore, authorized a more extensive testing programme be initiated to determine if asbestos was in fact present. It was found that a small percentage of the material was asbestos and therefore in accordance with the terms and conditions of our Lease Agreement with the Department of Fisheries and Oceans will have to be removed under the supervision of the Workers Compensation Board.
>
> The fire proofing material is a very hard cementation material and forms no risk or hazard in its undisturbed state ...

610 On July 10, 1987, Mr. Hall received a letter from Mr. Ken Stirling of Pinchin-Harris & Associates advising that:

> ... I would confirm that there is no immediate hazard presented to tenants on the third and fourth floors resulting from asbestos-containing materials found elsewhere in the building. This is the unanimous conclusion of an assessment conducted by representatives of Public Works Canada, Labour Canada and Health & Welfare Canada following a building survey undertaken on April 15, 1987 ...

611 On September 25, 1987, Mr. Sterling wrote again, this time advising that:

> ... I would confirm that there is no hazard presented to tenants on the sixth and seventh floors resulting from asbestos-containing materials found elsewhere in the building. This was the unanimous conclusion of an assessment conducted by representatives of Public Works Canada, Labour Canada and Health & Welfare Canada, with regard to third and fourth floor tenancies, following a building survey undertaken on April 15, 1987 ...

11 B.C.L.R. (3d) 1, [1995] 10 W.W.R. 385, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

612 Those letters, obviously, do not support the allegation that the plaintiffs embarked upon the removal of the asbestos-containing fireproofing material because of a concern for the health of the workers and occupants of the Building.

613 There is another highly significant piece of evidence that casts doubt on the plaintiffs' assertion that they embarked upon the abatement programme to protect the health of workers and occupants, and to eliminate the cause of damage to their property.

614 On April 16, 1987, Mr. Douglas Robinson, then the Asbestos Coordinator for the DPW, issued a report in which he provided his assessment of the state of the fireproofing in the Building. In his report, based upon a number of factors, he assigned an exposure number (or hazard rating) of six on a scale of zero to 171. His report contains the following explanation of the significance of this rating:

> A score of less than 12 indicates that the material can be considered stable and unlikely to present a health hazard. Asbestos abatement control measures are normally only required after a score of 10 is exceeded ...

615 The report goes on to state the following conclusion:

> *Although the fireproofing is not considered hazardous in its present state, the landlord has initiated removal procedures on the 3rd and 4th floors to comply with lease clauses ... as outlined previously, the material is tight, well bonded and stable. Fibre levels are therefore unlikely to reach hazardous levels unless the material is deliberately disturbed.* (emphasis added)

616 Given the impartiality of its source, this conclusion -- while admittedly made based upon limited inspection of the Building -- is particularly damaging to the plaintiffs' claim.

617 Because of the provision in the Lease Agreement warranting the Building to be asbestos-free, removal was the only option open to the owners. From their point of view, it would have been pointless to wait for the Pinchin-Harris report before making the decision because, even if Pinchin-Harris had recommended against removal, this would not have been satisfactory to the DPW. Mr. Hall confirmed as much in his evidence. He stated:

> Q. Mr. Hall, you said you personally or corporately determined asbestos must be removed from the third and fourth floors. Did you consider anything other than removal?
>
> A. We considered and discussed with our consultants, Pinchin Harris, what is referred to as encapsulation, which is the enclosing of the asbestos-containing material. *However, in this particular instance we had already warranted that the premises would be provided to the Department of Public Works asbestos free or free of friable asbestos and the encapsulation of the material would not encompass that.* (emphasis added)

618 On the evidence, I am satisfied that the decision to remove the asbestos-containing fireproofing material from the third and fourth floors was taken solely for the purpose of retaining the DFO as a tenant. Moreover, the evidence shows that the owners had no intention at that time of removing the material from any other part of the building, and none of the other tenants, save Sears, were advised of the presence of an asbestos-containing material.

619 I find the evidence on this matter to be of particular significance. The plaintiffs have repeatedly asserted their concern for the health of the occupants of the Building, in stark contrast to their unflattering characterizations of the conduct of the Grace defendants with regard to the continued manufacture and sale of MK-3 in Canada. Accordingly, I think it fair to emphasize that the plaintiffs' initial decision to remove the material from the third and fourth floors of the Building was clearly driven by economic, rather than health-related, considerations.

620 I will return to these matters, in greater detail, in the "Final Conclusions" section of this judgment.

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385,** 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

621 Notwithstanding my conclusion regarding the real motivating factor behind the decision to remove the asbestos-containing material, in my opinion, that finding would not be, in and of itself, fatal to the plaintiffs' claim if they had been able to demonstrate that, ex post facto, they learned of facts that would establish, on a balance of probabilities, that there did exist a health hazard sufficient to warrant the removal of the material, quite apart from the requirements of the lease.

622 To that end, I turn first to the report issued by Pinchin-Harris on May 2, 1987, entitled "Report on the Assessment and Control of Asbestos-Containing Insulation Materials in the Sears Spencer Building".

623 In connection with that report, Pinchin-Harris conducted surveys over six days during the months of March and April, and sent the samples in for testing. In argument, the Grace defendants detailed a number of concerns with regard to what they termed "the unscientific nature of the sample techniques" employed by Pinchin-Harris, and invited this court to view the results with scepticism. While I acknowledge their concerns, I am nevertheless satisfied that the procedures used were adequate so as to produce reliable results.

624 I should also mention one other related matter. The Grace defendants argue that the plaintiffs have failed to prove that MK-3 was the product that was tested and eventually removed from the Building. They say that the plaintiffs have failed to take account of the history of the Building and the likelihood (if not the certainty) of many other asbestos-containing products having been installed in it before 1972.

625 There is a substantial body of evidence which shows that approximately 250 tons of MK-3 was installed in the Building by Donalco between 1972 and 1975. Several of the tests that were made revealed a chrysotile asbestos content "consistent" with MK-3. I am satisfied that the plaintiffs have discharged the burden of establishing the presence of that material in the Building. The real questions are: (i) did it contaminate the Building; and (ii) was it hazardous to health?

626 Returning to the Pinchin-Harris Report, the results of the tests of these samples revealed the presence of four types of friable ACM in the Building: preformed thermal insulating product; corrugated paper products; finishing cement; and spray applied products.

627 The Report provides a floor-by-floor breakdown detailing the presence, condition and potential for disturbance of the ACM. The assessment of condition and potential for disturbance was made in accordance with factors set out by a U.S. EPA Guidance Document.

628 I think it worthwhile to reproduce here the findings of the Report:

> **9th Floor:**
>
> This floor encompasses the "old" (Spencer) section of the building structure from grid lines G-L/1-10. The space is largely open with the exception of sprinkler tanks occupying the majority of space on the west side of the floor, an emergency generator room and three elevator machine rooms. Mechanical insulation materials are limited to preformed thermal products on a Water Tank/Separator (no longer in use) and finishing cement on pipe elbows. Such materials are in very good condition. Sprayed-fibre (Mineral fibre) fireproofing is applied to the deck and oversprayed on beams and is exposed throughout the floor. This material is also in very good condition but sees limited access during maintenance procedures. Access to the floor is limited to building maintenance personnel.
>
> Assessment: Mechanical Insulation -- Good Condition -- Low Disturbance Potential
>
> **8th Floor:**
>
> This floor encompasses the "old" side of the building and is used predominantly for storage of materials. The floor at one time contained a kitchen as evidenced by building materials found on the floor. Mechanical Insulation materials were observed to be glass fibre along water lines including elbows and tees. Cementitious fireproofing (Monokote) is applied to the deck and oversprayed on the beams and is exposed throughout the floor. All materials

11 B.C.L.R. (3d) 1, [1995] **10 W.W.R. 385**, 23 C.L.R. (2d) 1, 128 D.L.R. (4th) 577

were observed to be in good condition. Access to the floor is limited.

Assessment: Mechanical Insulation -- Good Condition -- Low Disturbance Potential

Spray-applied Insulation -- Good Condition -- Low Disturbance Potential

8th Floor Void Space:

This space circumvents the southwest side of the building and contains pipes left in place from the old chiller system. Mechanical insulation on these pipes has delaminated over extensive areas and significant amounts of debris were observed on the floor slab. Access to this area is limited to the 8th floor.

Assessment: Mechanical Insulation -- Poor Condition -- Low Disturbance Potential

7th Floor:

This floor encompasses the "old" side of the building and comprises a number of office areas. A suspended ceiling is in place over the entire floor with the exception of the drywall ceiling in place over the central corridor. Mechanical Insulation materials, found in the ceiling space, were observed to be glass fibre along water lines and over ducted air systems. Cementitious fireproofing (Monokote) is applied to the deck from grid lines 2-9/J-L, but does not appear to have been applied down the sides of secondary beam structures of the double-tee construction. Q Deck assemblies found in a few areas of the deck were also sprayed with what appears to be a contiguous application of Monokote. No fireproofing was observed in the area encompassed by grid lines J-G/1-10 or in areas 1-2/J-L and 9-10/J-L. Monokote applications appear in relatively good condition with the exception of those areas where the installation of ceiling and duct hangers has resulted in disturbance. Access to the ceiling space is limited to building maintenance personnel and authorized renovation trades.

Assessment: Spray-applied Insulation -- Good Condition -- Low Disturbance Potential

6th Floor:

This floor encompasses the "old" side of the building and comprises one large office area. The floor is currently vacant. A suspended ceiling is in place over the entire floor. Mechanical Insulation materials, found in the ceiling space, were observed to be glass fibre along water lines and over ducted air systems. Cementitious fireproofing (Monokote) is applied to the deck and oversprayed on beams. Monokote applications appear in relatively good condition with the exception of those areas where the installation of ceiling and duct hangers has resulted in disturbance. Access to the ceiling space is limited to building maintenance personnel and authorized renovation trades.

Assessment: Spray-applied Insulation -- Good Condition -- Low Disturbance Potential

5th Floor:

This floor encompasses the "old" side of the building and is currently used by Sears as a warehouse area. A suspended ceiling is in place over the entire floor. Water stains observed on ceiling tiles are not indicative of water damage above. This observation was confirmed by the building engineer who indicated that tiles on this floor are used to replace water damaged tiles in other Sears areas. Mechanical Insulation materials, found in the ceiling space, were observed to be glass fibre along water lines and over ducted air systems. Cementitious fireproofing (Monokote) is applied to the deck and oversprayed on beams. Monokote applications appear in relatively good condition with the exception of those areas where the installation of ceiling and duct hangers has resulted in disturbance. Access to the ceiling space is limited to building maintenance personnel and Sears Sales and Security Personnel.

Assessment: Spray-applied Insulation -- Good Condition -- Low Disturbance Potential